Video level meter
PM5548

Instruction manual

9499 493 01911
811106/04

S&I
Scientific & Industrial Equipment Division

PHILIPS

PHILIPS

MP MASTER
MA24523

Video level meter
PM5548

Instruction manual

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811106/04

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In correspondance concerning this instrument, please quote the complete type and serial number, as given on the identification plate at the rear of the instrument.

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GENERAL INFORMATION

1. Introduction

The PM 5548 is a very accurate analysis instrument meeting the stringent demands in TV broadcasting. It measures the instantaneous level at any point of a composite video signal. The instrument is ideal for checking and aligning all kinds of video equipment such as pattern generators, test generators, encoders, decoders, mixers, insertion test signal generators etc.
Besides meeting the growing demands for higher measurement accuracy it offers effectiveness and rationalization in setting of video levels.

The PM 5548 is a multi-system instrument: when switching from one system to another, only the notch filter has to be readjusted (4.43MHz or 3.58MHz).

2. Technical data

This instrument has been built and tested according to IEC publication 348 for Class 1 instruments and has been supplied in a safe condition. The present Instruction manual contains instructions and warnings which should be followed by the purchaser to ensure safe operation and to keep the instrument in a safe condition.

Properties expressed in numerical values with standard tolerances are factory guaranteed. Those without tolerances are typical values.

Inputs

1. Video or composite video
   (sync negative)
   Input impedance : 75Ω ±0.1%

2. Sync input
   Amplitude : 1-8Vpp
   Impedance : 75Ω looped through

Digital display

4 Digits, seven segment, high bright, 0.8".
Readings direct in millivolts referred to the blanking level.
Indication of no sync in the incoming video signal.

Polarity

Automatic polarity indication. Positive levels are above blanking level.

Range : -600 to +1400mV

Accuracy

At 25-35°C ambient temperature : 0.1% of reading ±1 digit
signal/noise ratio : >30dB

Sampling pulse

Vertical; start : line no. 1 to 625 (thumbwheel switches)
height : 1 to approx. 50 lines
Horizontal; start : delayed 2-64µs from leading edge of sync pulse
width : 0.3 to 5µs continuous variable

Measuring time

Depending on sampled area (height x width) and level shift. Typical value at 1 line, 1µs width and 100mV level shift: 200ms.

A/D converter

Dual slope with automatic polarity indication.
Integration time 100ms.

Outputs

1. Video and marker

marker pulse	: ±0.5V superimposed on filtered incoming video signal
output impedance	: 75Ω
video input/output ratio	: ∿1

2. Marker

marker output	: >±4Vpp
load	: >1kΩ

Temperature range

Operating temp.	: 0°C to +45°C
Storage temp.	: -20°C to +75°C

Power supply

Mains voltage	: 115/230V ±20%
Mains frequency	: 48Hz to 65Hz
Safety classification	: Class 1 equipment
Power consumption	: 25VA at 220V
Fuse 115V range	: 600mA, delayed action
230V range	: 315mA, delayed action

PM8509 BCD output, (optional)

Output code : Positive BCD
Low level : 0 - 0.4V
High level : +5V to +12V (determined by the value of GR601)

Result : 13 bit from the memory
BCD code (1 - 2 - 4 - 8)

Polarity : 2 bit code

	(4)	(2)
+	0	1
-	1	0

Print (transfer)	: Appears at the end of the measuring cycle. Two pulse curveforms are possible (pulse width approx. 50µs). a) A negative going pulse, when a jumper connects terminal a to b. b) A positive going pulse, when a jumper connects terminal c to d. N.B. The option is delivered without any jumper.
Stop	: "0" (negative going pulse) low level = 1V.
Start	: "1" (minimum pulse width 100µs) high level = 5V to 50V.

Mechanical data

Width	: 3/6 module in PHILIPS universal 19" system
Height	: 132mm (3 units)
Depth	: 400mm
Weight	approx. 4kg

3. Accessories

1 Instruction manual

1 Mains cord

1 BNC termination

4 BNC-connectors

1 Fuse

OPTION available
PM8509 BCD output unit

4. Description of the block diagram

This chapter contains a functional description of the block diagram fig. 4-2.

Input

The video signal to be checked is applied to the input amplifier via an input stage which has an input impedance of 75Ω. After passing the notch filter (f subc) the signal is led to the video amplifier and amplified 5 times.
The amplified signal is clamped at the blanking level by the clamp circuit.
Via the video follower the signal will reach the "sample and hold" circuit. Here the signal is sampled and held during a certain time, determined by the setting of the horizontal and vertical position selectors i.e. width and height (generating the position pulse).

A/D converter

In the following A/D converter the DC voltage obtained by the sampler will be converted into a digital signal by the dual slope method. Basically the A/D converter consists of an integrator, a zero detector and some switch circuits for positive and negative reference voltages. The digital signal from the counter (0-2000) is first stored and then transferred to the display section. Any variation of the measured level is detected, and the new value is displayed and retained until it varies again. The A/D converter has automatic polarity indication and has a BCD output for the digital output option.

Marker pulse generator

In order to visualize the point being sampled, the position pulse is also used as a trigger pulse for the marker pulse generator.
This generator has a manual control for the polarity of the marker signal.
After being amplified in the marker amplifier the signal is applied to the "MARKER" output terminal. The marker output signal is also added to the amplified video signal. This mixed signal is then amplified and fed to the "VIDEO AND MARKER" terminal (see fig. 4-1).

The position pulse

The position pulse mentioned above is derived from the line- and field information (f_H and f_V) provided by the sync separator. The sync separator consists of a clamp pulse generator, a clamp circuit and a line- and field separator. The input signal for this circuit is either a video signal with sync (the sync switch in position "INT") or an external sync signal applied to the sync amplifier via the "EXT SYNC" input terminal (the sync switch in position "EXT").
External sync is to be used when measuring video signals without sync signal.
The position pulse is determined by four controls: "LINE NO", "DELAY", "WIDTH" and "HEIGHT".

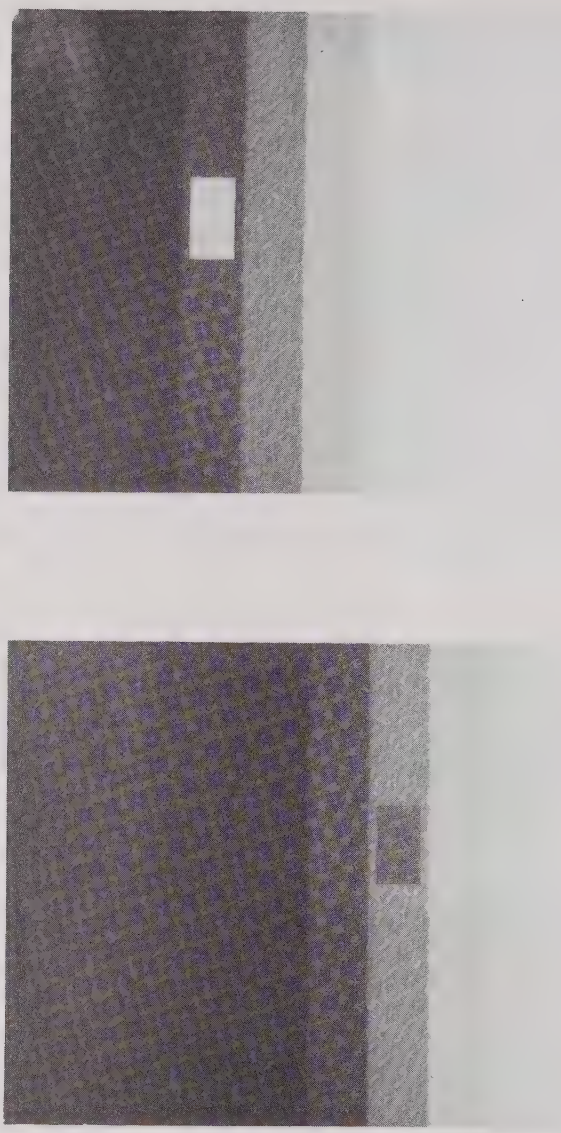


Fig. 4-1 Video signal with superimposed marker pulse

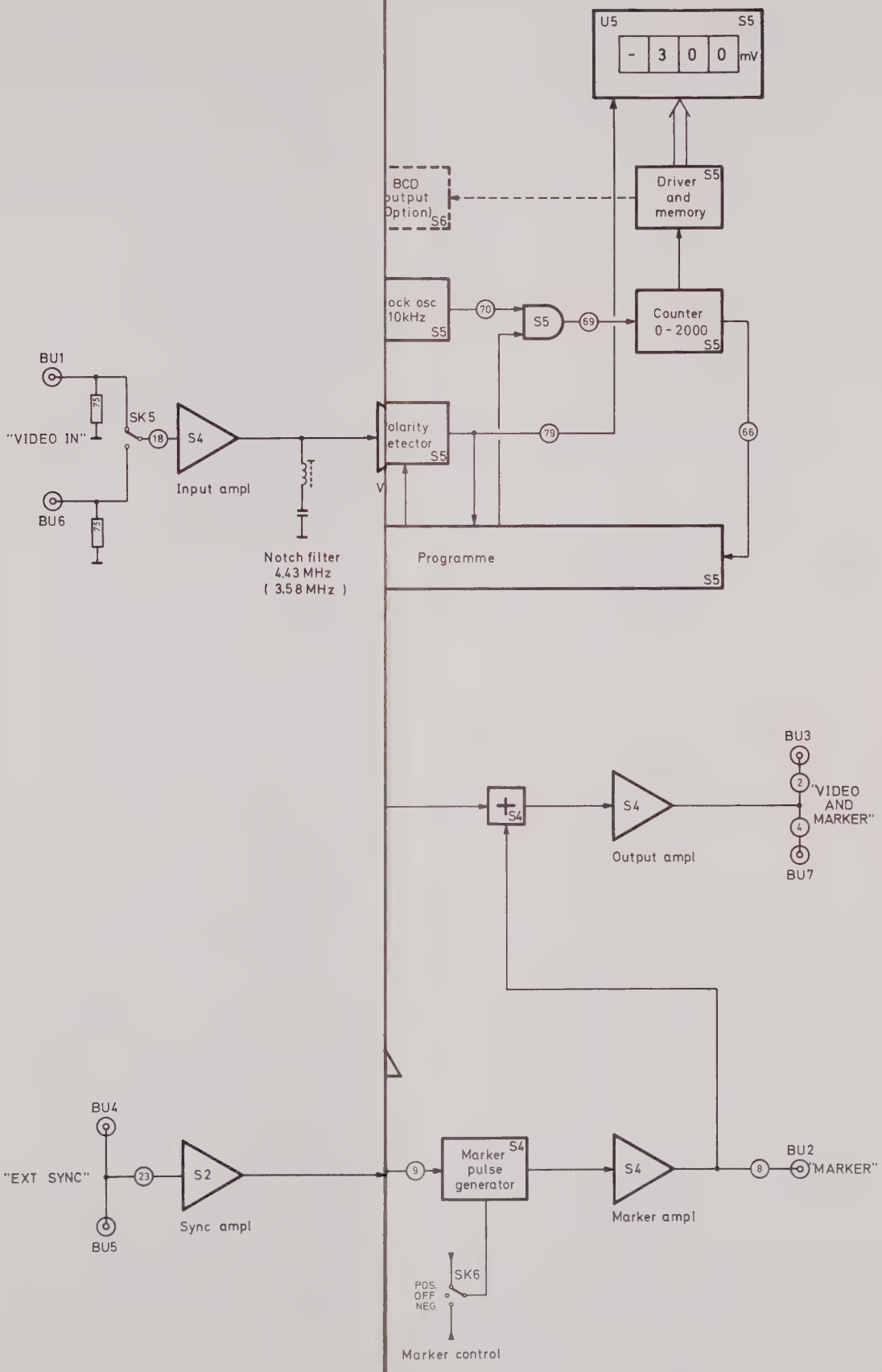


Fig. 4-2 Block diagram

5. Installation

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section EARTHING).

Mains adjustment and fuse

The PM 5548 is powered directly from the mains supply. It is capable of operating on either 115 or 230V, 48 or 65Hz. Prior to shipment from the factory, each instrument is wired for 230V, unless otherwise specified when ordered. Before inserting the mains plug into the mains socket, make sure that the instrument is set to the local mains voltage.

Make sure that only fuses with the required current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuseholders shall be avoided.

The fuse shall be replaced only by a skilled person who is aware of the hazard involved.

The instrument shall be set to the local mains voltage only by a skilled person who is aware of the hazard involved.

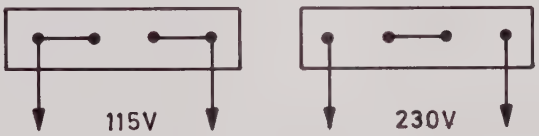


Fig. 5-1 Transformer connections 115V-230V

Earthing

Before the instrument is switched on, it shall be connected to a protective earth conductor in one of the following ways:

- via the protective earth terminal BU15
- via the three-core mains cable. The mains plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor. Replacing the mains plug is at the users own risk. After replacing a mains plug, a high-voltage test in accordance with IEC Publication 348 is strongly recommended.

Warning:

- Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous.
- Intentional interruption is prohibited.
- When an instrument is brought from the cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.

Mounting in a cabinet

The instrument is a 3/6 module of the PHILIPS standard 19" system and can be housed in either a 3/6 standard cabinet PM9713 or together with e.g. the video calibration generator PM5546 in a full 19" cabinet PM9716 (6/6 module).

6. Survey of controls and sockets

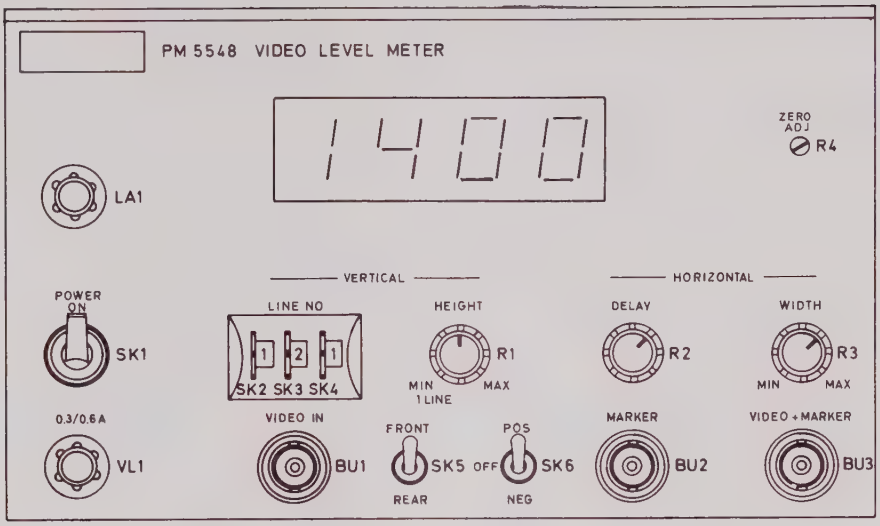


Fig. 6-1 Front of the instrument

LA1	Pilot lamp; lights up when the instrument is switched on.
SK1	"POWER ON" Mains switch, the instrument is switched on when the lever of the switch is placed upwards.
SK2, 3 and 4	"LINE NO" Thumbwheel switches; preset the line number to start sampling.
R1	"HEIGHT" Vertical control of the area being sampled. The control has a fixed mechanical position for 1 line.
R2	"DELAY" Control of the horizontal delay from leading edge of sync pulse to the sampling point.
R3	"WIDTH" Horizontal control of the area being sampled.
R4	"ZERO ADJ" Screwdriver control for zero adjustment or the instrument.
BU1	"VIDEO IN" Input socket couples the video signal to the input selector SK5.
SK5	"FRONT-REAR" Lever switch with two positions; to select video input signal from the front panel or from the rear panel.

BU2 "MARKER"
Output socket for the marker pulse controlled by selector SK6.

SK6 "POS - OFF - NEG"
Lever switch for positive, negative or none marker pulse.

BU3 "VIDEO + MARKER"
Output socket for the incoming video signal filtered and superimposed with marker pulse.

VL1 Safety fuse 230V - 315mA delayed action
115V - 600mA delayed action

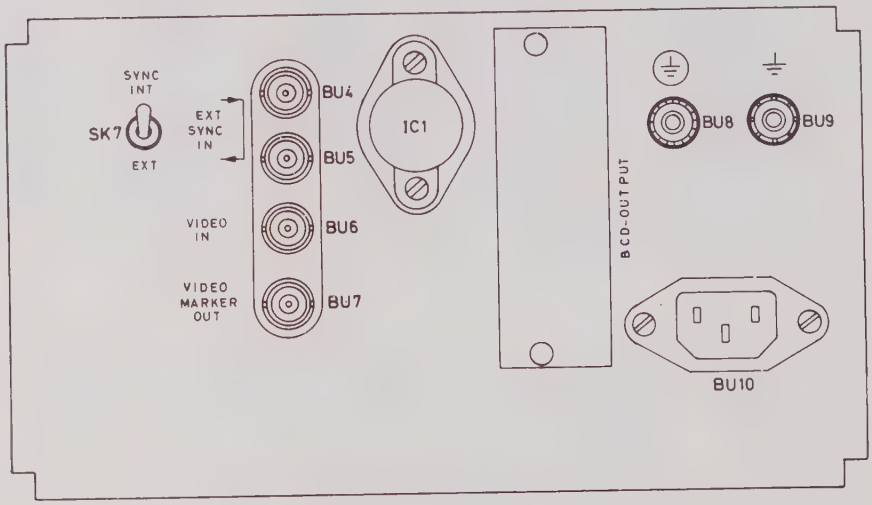


Fig. 6-2 Rear of the instrument

SK7 "EXT. - INT."
Sync switch with two positions; to select between ext. sync and int. sync mode.

BU4, BU5 "EXT. SYNC"
Looped-through input sockets for the external sync signal.

BU6 "VIDEO IN"
Input socket couples the video signal to the input selector SK5.

BU7 "VIDEO + MARKER"
Output socket for the incoming video signal filtered and superimposed with marker pulse.

BU8
Earhting socket connected to the cabinet.

BU9
Earthing socket connected to the electrical circuit.

BU10
Mains socket

7. Operating the PM5548

Connect the instrument to the power line and set SK1 in position "ON".
Set the sync switch SK7 in position "INT" and supply the video signal with sync, intended to be examined, to the input terminal BU1 or BU6 "VIDEO IN". Set the video switch SK5 in proper position according to the input terminal used. If the video signal has no sync pulses, an external sync signal can be connected to terminal BU4 or BU5 "EXT SYNC". Sync switch SK7 in position "EXT".
Connect a monitor or an oscilloscope to the output terminal BU3 or BU7 "VIDEO + MARKER" and preset the desired line number by means of the thumbwheel switches SK2, SK3 and SK4. For a visual indication of the measuring field on a monitor screen, it is recommended to set the "HEIGHT" and "WIDTH" controls in their max. positions to obtain the largest area. SK6 controls the marker polarity as well as the presence of the marker area (see fig. 7-1 and 7-2).
By means of the area controls mentioned above it is possible to determine the position and size of the measuring area, and measure the video level.
The result is displayed on the digital display, and the entire measuring range is -600mV to +1400mV direct readings. The zero adjustment of the instrument is carried out when the measuring field is a pure blanking level.

Fig. 7-1 Black (negative) marker area

Fig. 7-2 White (positive) marker area

Important

Before using this instrument please note the following remarks:

1. Video signals with non-standard sync.

Basically the PM 5548 is designed for measurements of video signals with standard interlaced composite sync signals. Only for such signals the line number of the TV lines are defined.
If video signals with simplified sync information have to be measured then the following points should be observed:

a. Video signals with comp. sync having no interlacing i.e. there is a fixed ratio (even number) between the line and the field frequencies:
The line selector can be used to position the sampling (and the marker) pulse anywhere in the field. The repetition frequency of the sampling pulse will be 25Hz.

b. Video signals with composite sync having random interlacing i.e. there is no fixed relationship between the line- and the field frequencies:
Due to the random interlacing the sampling pulse will be situated at random in either every field or in two adjacent fields - but the distance between two adjacent sampling pulses will be nearly constant (equal to the width of one or two fields).
At lines near the field pulses the display will fluctuate.
It is recommended to switch off the field information if possible ("field off", see point C).

c. Video signals without field information.
The measurements are performed normally, but the function of the line selector is without means. The distance of two adjacent sampling pulses will be 1000 lines independent of the setting of the thumbwheel switches.

2. "Video + Marker" outptut

Remark: The output signals have the following qualities:

a. nearly the same amplitude as the incoming signal
b. the signal is not clamped
c. the signal passes through a notch filter, where the chroma information is removed.

3. Ext. sync.

Remark: The "Int./Ext. Sync" switch is situated near the sync input at the rear plate.

4. Zero adjustment

Remark: The zero adjustment for the instrument (zero adj. at the front plate) shall be performed only when a signal is fed to the input (as a measurement of a pure blanking level). With no signal the display shows not only 000mV, but the absence of sync ~~is~~ visualized by four illuminated decimal points.

Finally two suggestions:

5. "Marker"

We recommended that the "Marker" output should be used for triggering the oscilloscope.

6. Position identification

To enable easy identification of the marker pulse (display on oscilloscope or monitor screen) use the knobs "Height" and "Width" more or less in their max. positions or switch between positive or negative marker.

SERVICE INSTRUCTIONS

The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts; accessible terminals may also be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.

If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.

Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

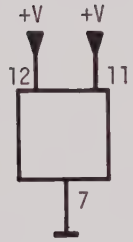
In the following chapters the circuitry of the units has been explained.
The service adjustments, if any, have been described at the end of the chapter concerned.

Please bear in mind the following notes:

- The tolerances mentioned are factory tolerances which apply when readjusting the instrument. They may differ from these as shown in the section "General information" chapter 2 "Technical data".
- The voltages shown in the published oscillograms have been measured with respect to pin 10.
- The d.c. voltages have been measured with a PHILIPS d.c. voltmeter PM2441.
- The oscillograms have been measured with a PHILIPS oscilloscope PM3250 or PM3330 and photographed with a PHILIPS camera outfit PM9380.
- Before adjustments are made, the instrument should have been switched on for more than 15 minutes.
- The diagrams are provided with figures for reference; 8a in the diagram for example refers to oscillogram no. 8 trace a. (2) in the diagram, for example, refers to test point no. 2 on the printed wiring board.

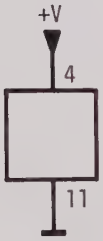
IC power connection

SN7400N SN7430N SN74123N
SN7402N SN7442
SN7410N SN7472N
SN7416N SN74121N
SN7427N SN74122N



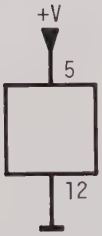
LM723C

SN7490N



SN7473N
SN7474N

SN74LS247



SN7475N

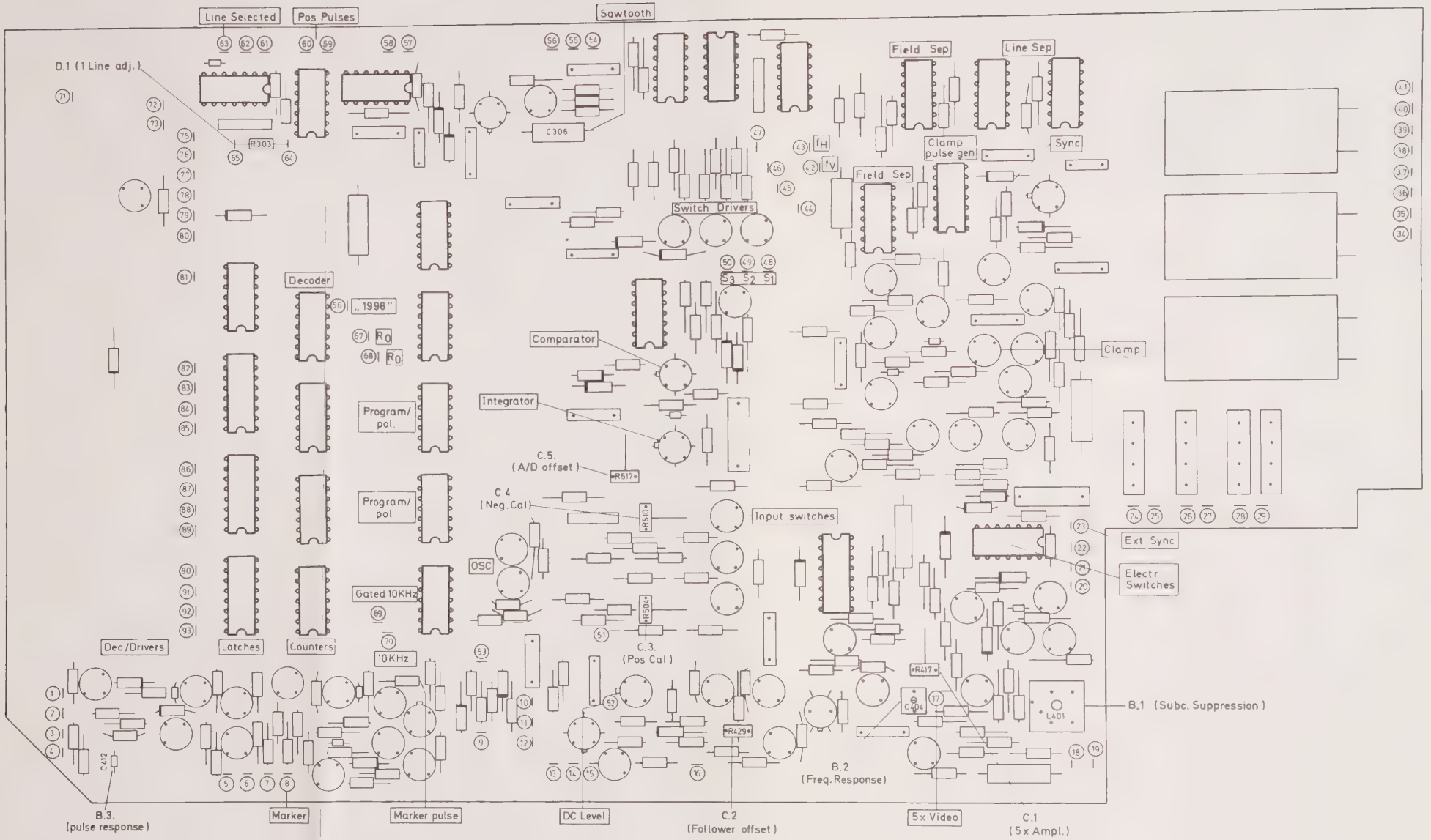
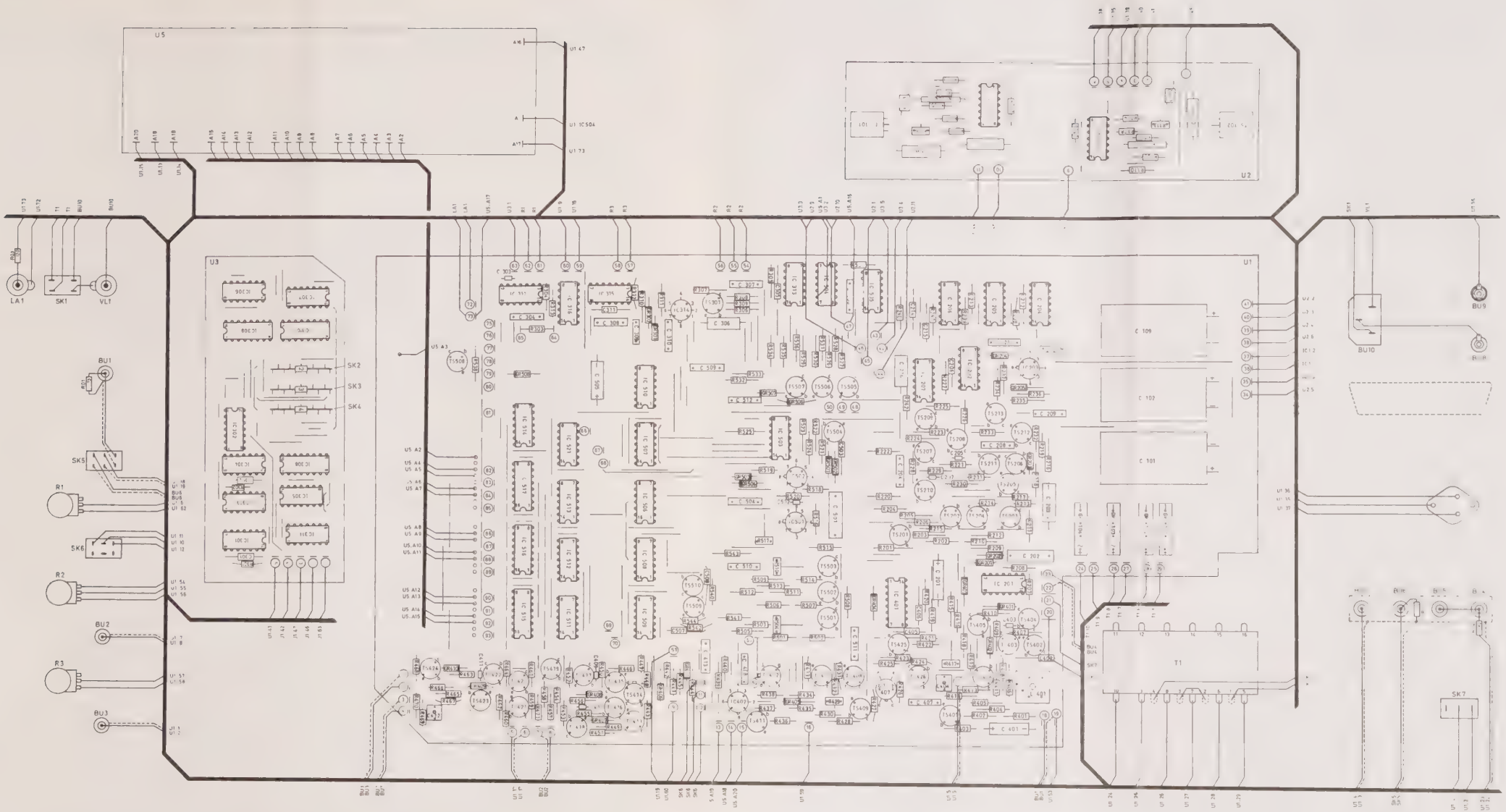
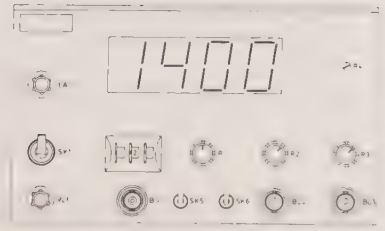


Fig. 8-1 Survey of adjusting elements





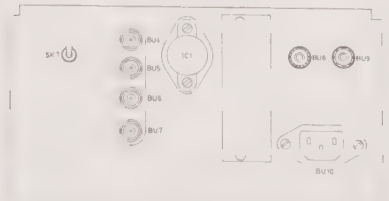


Fig. 8-2 Wiring diagram

8. Section 1. Power supply

The voltage regulator supplies three stabilized DC voltages; +15V, +5V and -10V. The three voltages are protected against short circuiting between any of the DC voltages and earth.
IC101 and IC102 are monolithic voltage regulators. The device consists of a temperature compensated reference amplifier, error amplifier, power series pass transistor and current limiter.
Additional NPN transistors TS101 and TS102 are used to control the output current.
The device features low stand-by current drain, low temperature drift (important for the A/D converter) and high ripple rejection. The principle in the operation is to compare the internal reference voltage $V_{ref.}$ with part of the wanted output voltage $V_{O'} = V_{ref.'}$
The level of the output current is limited to a constant value, typ. 270mA, by means of the external current limiter resistors R104 and R111.
IC1 is a complete fixed +5V regulator including current limiter (typ. 1A). In addition thermal shutdown is provided to keep the IC from overheating.

Checking and adjusting

Measuring equipment:
Digital voltmeter : e.g. PHILIPS PM 2528

+15 V

Connect the voltmeter to terminal 11 (earth at terminal 10).
The voltage should be exactly +15,00V, if not, adjust it by means of R106.

-10 V

Connect the voltmeter to terminal 1 (earth at terminal 10).
The voltage should be exactly -10,00V, if not, adjust it by means of R113.

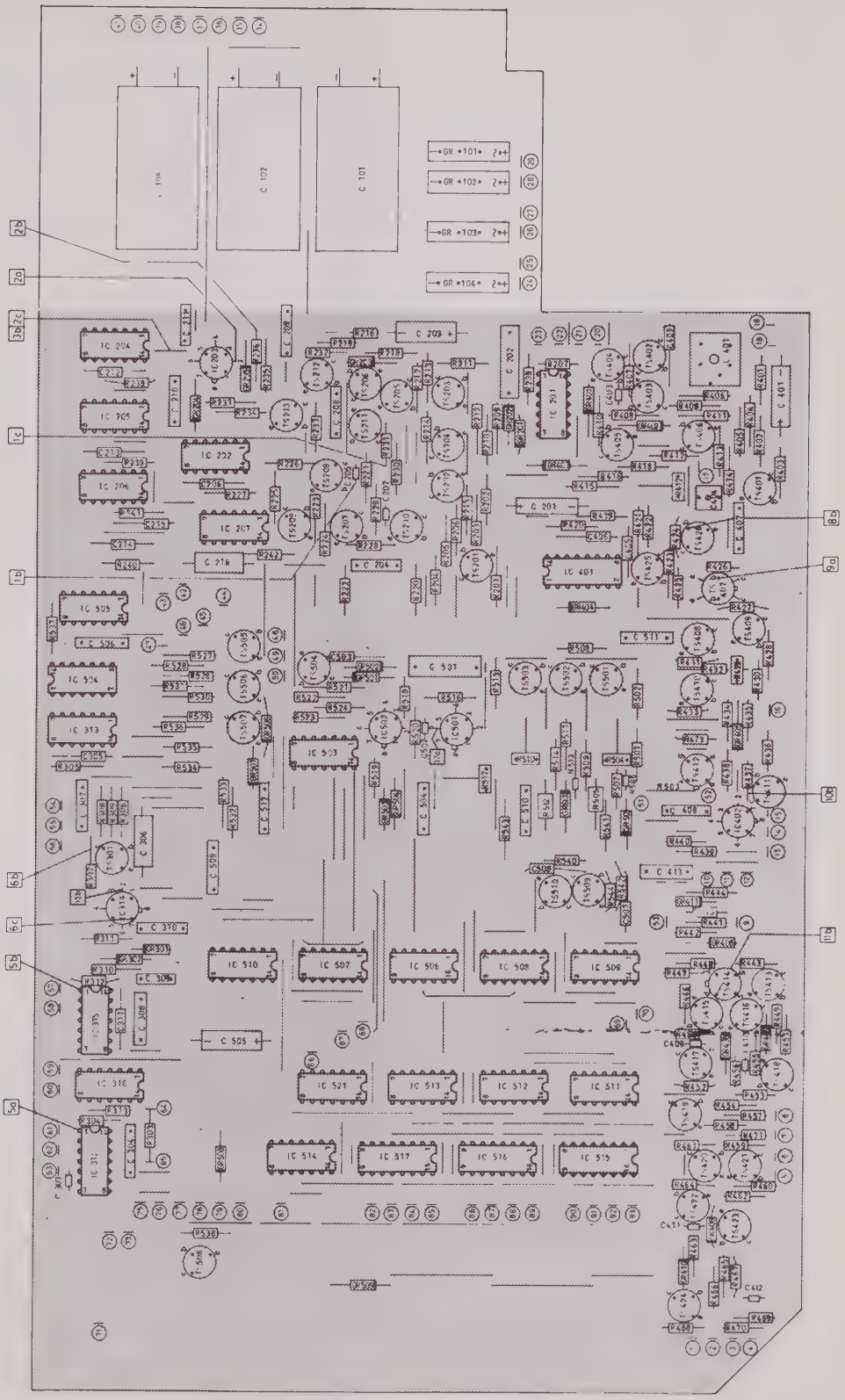


Fig. 8-3 Component location, power supply, section 1 unit 1

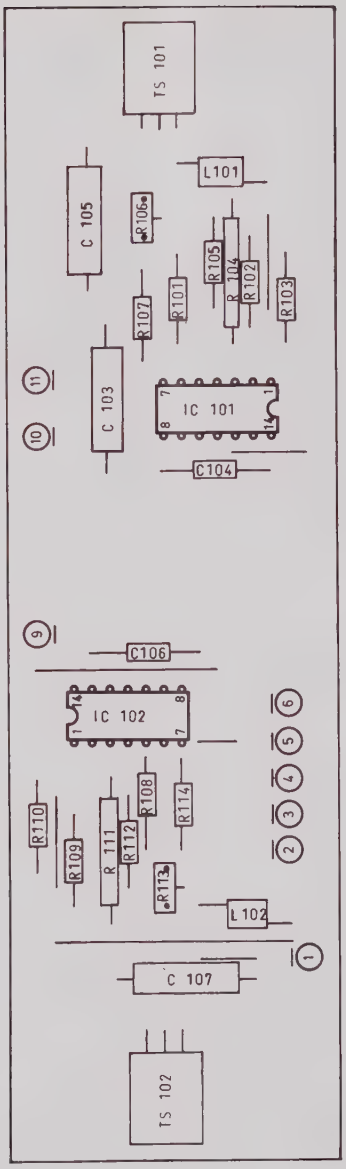


Fig. 8-4 Component location, voltage regulator, section 1 unit 2

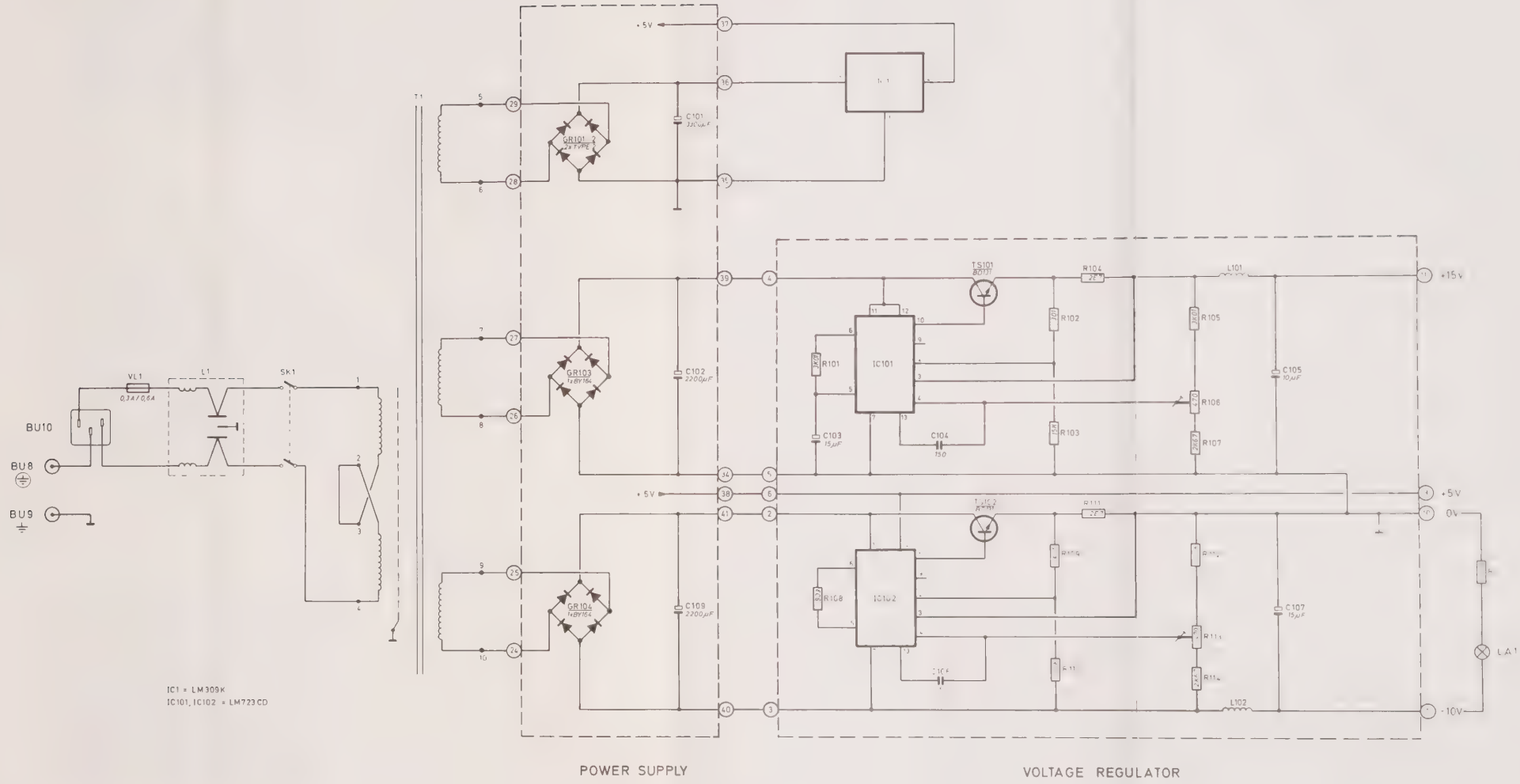


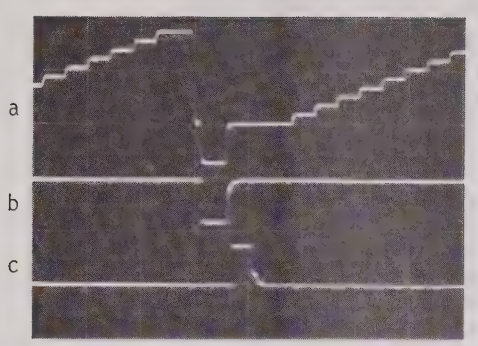
Fig. 8-5 Circuit diagram, power supply, section 1

9. Section 2. Sync. separator

The sync separator has two inputs: one for a video signal with sync and one for an external sync signal. External sync is used when measuring on video signals without sync signal. The two input-stages consist of emitter follows securing the high input and low output impedance. The switching between the two channels is performed by means of SK7 forcing IC201 to cut off either TS202 or TS204, and consequently also the signal. The circuit consisting of TS205 and TS206 gives the necessary low ouput impedance to the clamp circuit.

Via clipper stage TS207 the sync information is separated from the video signal and then converted to levels allowing triggering of IC202. This is a one-shot activated at the trailing edge of the inverted sync signal. The following transistor TS210 is a driver for the clamp transistor TS211, formed by a FET transistor with low on-resistance. The clamped video signal is applied to a negative peak detector accomplished by TS212 and TS213.

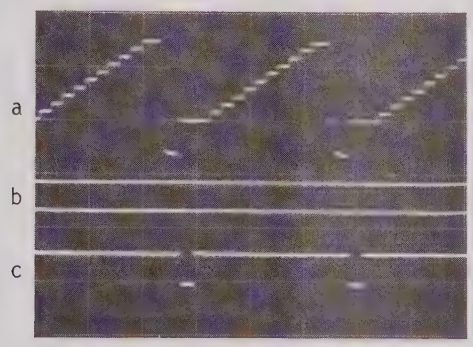
IC203 compares half the peak sync voltage with the clamped video signal resulting in a correctly shaped sync signal at the output from which the horizontal and vertical information is derived via one shots IC205 and IC207. The width of the line pulse is about 8µs and of the field pulse about 210µs.



position of clamp pulse

10µs/div.

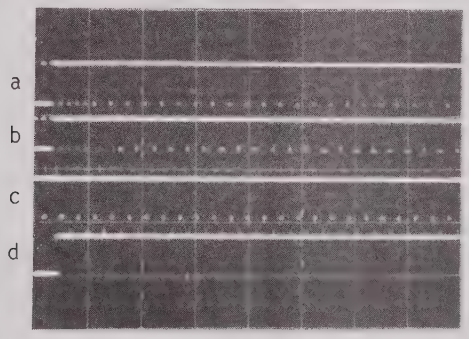
a. ref.: int. sync	(17)	2V/div.
b. separated sync signal	[1b]	20V/div.
c. clamp pulse	[1c]	20V/div.



sync shaper

20µs/div.

a. video signal with sync	[2a]	2V/div.
b. half clamp level	[2b]	1V/div.
c. clamp output	[3b]	5V/div.



sync separator

0.2ms/div.

a. ref. ext. sync	(23)	10V/div.
b. clamp output	[3b]	5V/div.
c. f_H	(43)	5V/div.
d. f_V	(42)	5V/div.

Fig. 9-1 Oscillograms section 2

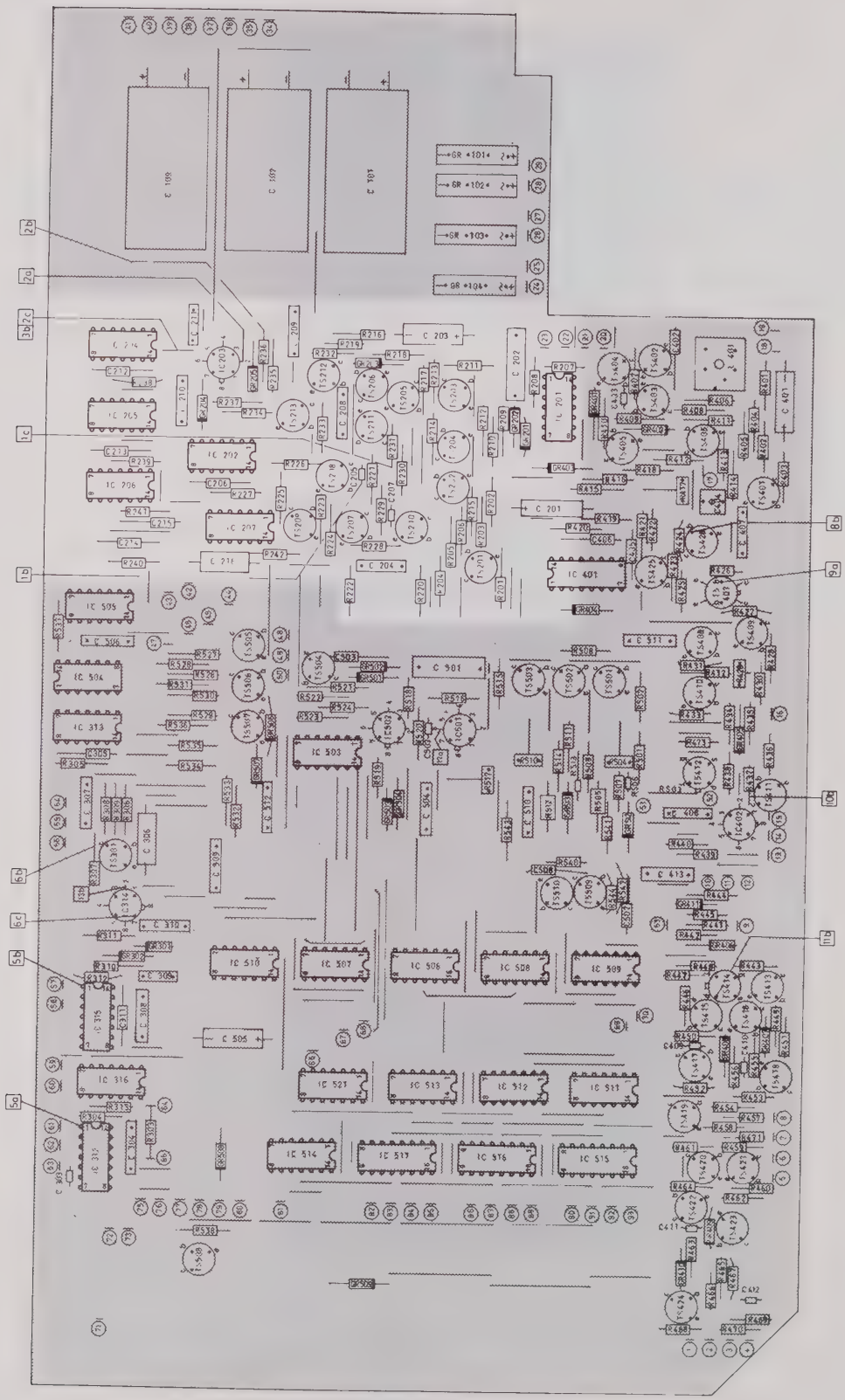


Fig. 9-2 Component location, sync separator, section 2

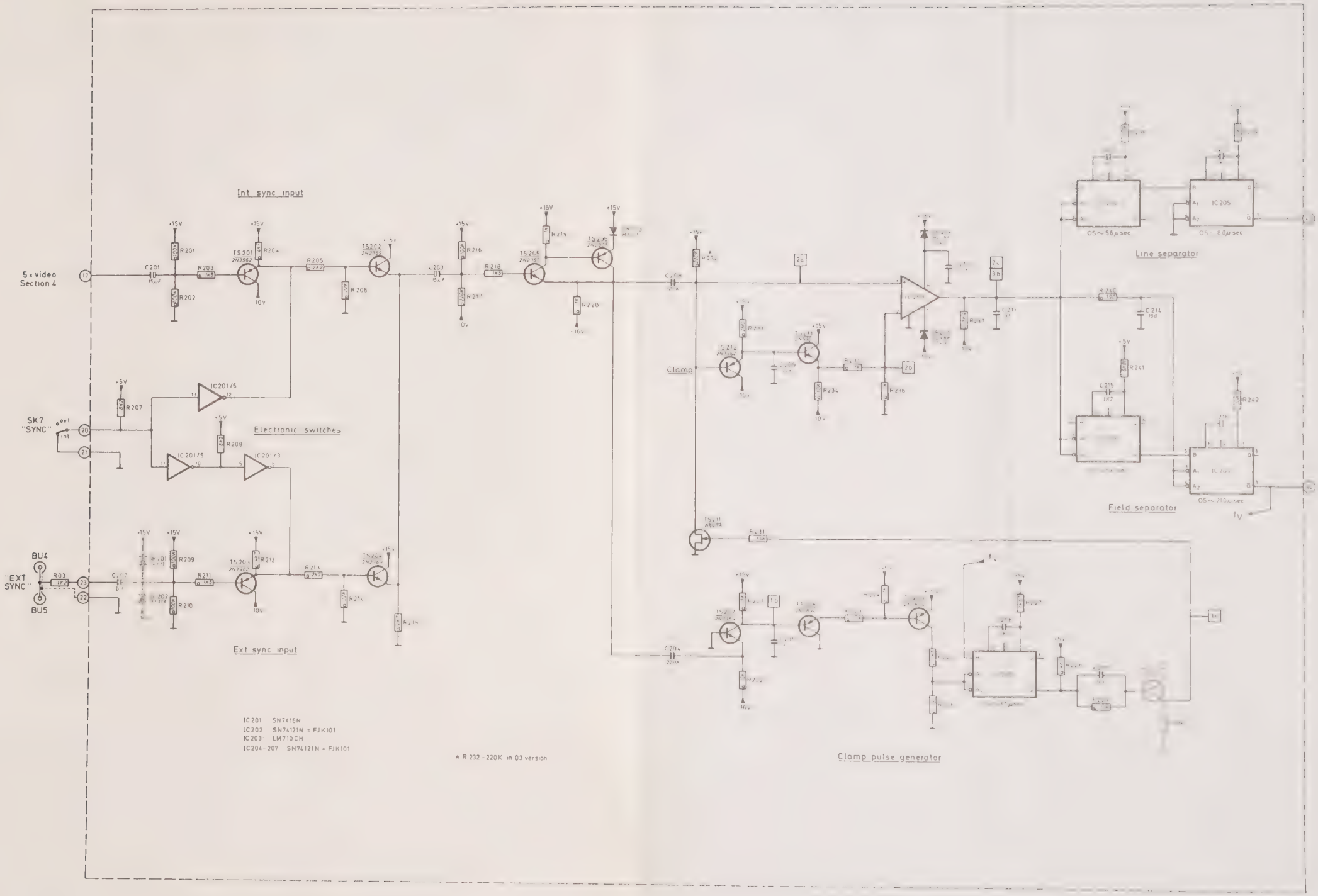


Fig. 3 Circuit diagram, sync separator, section 2

10. Section 3. Line and position selector

The position of the sampling pulse (position pulse, terminal 59) is determined by four front panel controls:

a. The thumbweel switches SK2, SK3 and SK4 which directly indicate the line number for the sampling to start.

b. The area control "HEIGHT" (R1) which determines how many lines will be sampled (1 to approx. 50 lines).

c. The multiturn potentiometer "DELAY" (R2) which gives the sampling point on the selected line (S).

d. The area control "WIDTH" (R3) which determines the width of the pulse.

The line number is selected by means of a counter system counting line pulses and reset by a field select pulse. The output information from the counters (IC305, 306 and 307) is in BCD code, and is decoded to decimal code (IC308, 309 and 310), so that the line number can easily be selected by the thumbweel switches. After that a one-shot generator (IC312) enlarges the triggerpulse depending on the setting of R1 ("HEIGHT") to a maximum of 50 lines.
The horizontal delay (2 to 64µs) from the leading edge of the line pulse is formed by comparing a sawtooth voltage with a reference voltage in a comparator (IC314). With the knob "HEIGHT" turned to 1 line-position it is possible to select, by means of R303, the delay for IC312 to be 64µs. The width of the sampling pulse (position pulse) is derived from a one-shot generator (IC315) ranging from 300ns to 5µs, determined by R3. Finally the two pieces of information are gated together in a NOR-gate (IC316) and can be measured at terminal 59 and 60.

Checking and adjusting

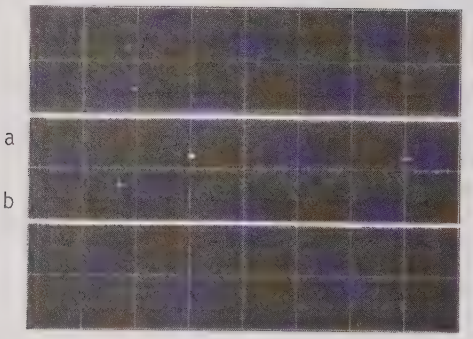
Measuring equipment:

Oscilloscope : e.g. PHILIPS PM 3240X

Delay of the position pulse ("HEIGHT" function).

Connect oscilloscope to pin 63 and the other trace to IC312, pin 1.
Turn R1 "HEIGHT" to position 1 line.
The delay should be 64µs.
If not, select another value for R303 (6.8kΩ - 22kΩ).

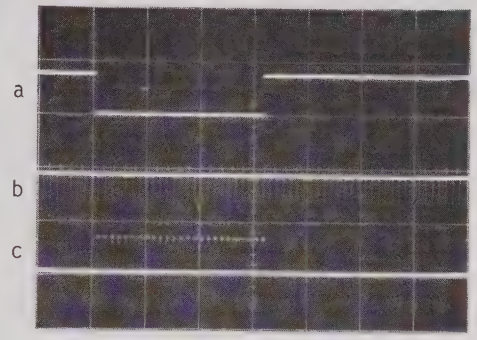
Line selected (line no. 210)



a. ref.: f_V (42)

b. Line no. 210 (63)

Construction of the position pulse

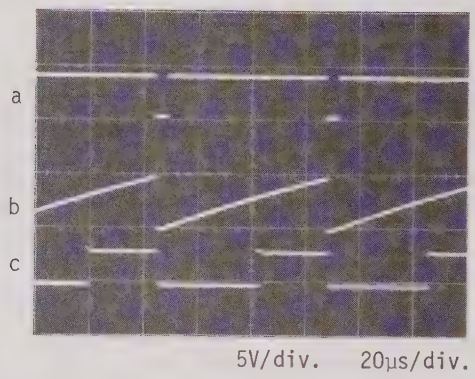


a. "HEIGHT" information [5a]

b. "Delay" information [5b]

c. Position pulse (60)

"DELAY" circuit

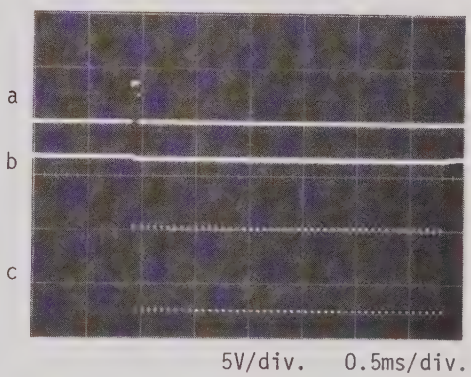


a. ref.: f_H (43)

b. sawtooth [6b]

c. delay output [6c]

Position pulse



a. ref. line 210 (63)

b. $\overline{\text{position pulse}}$ (59)

c. position pulse (60)

Fig. 10-1 Oscillograms, line and position selector, section 3

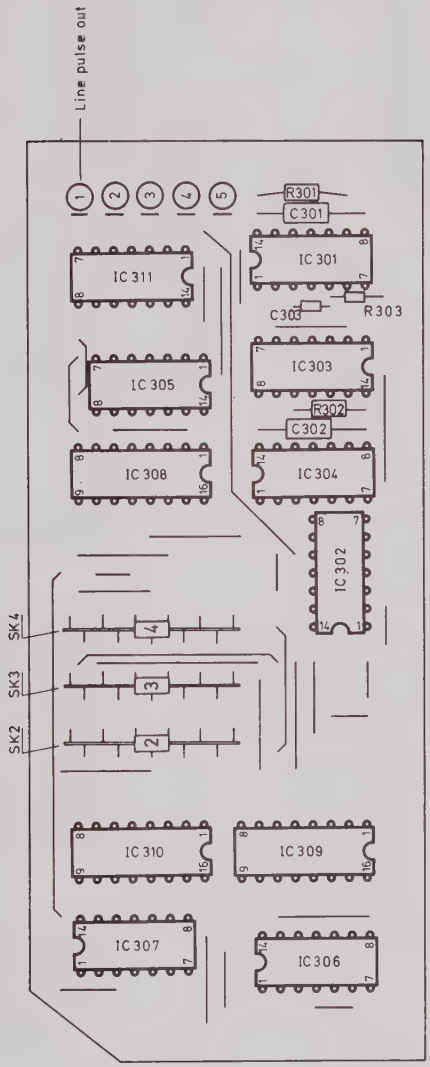


Fig. 10-2 Component location, line and position selector, section 3 unit 3

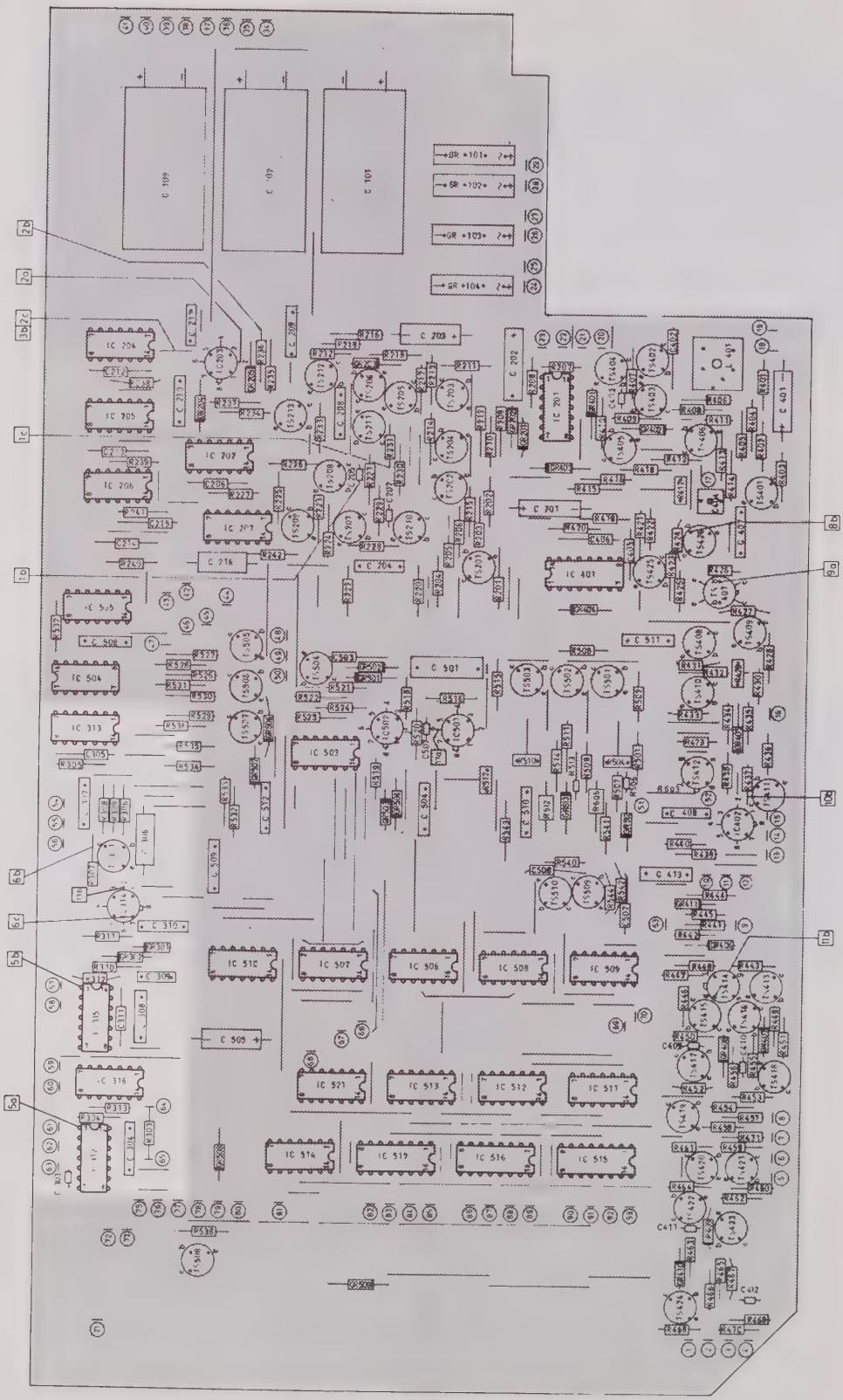


Fig. 10-3 Component location, position selector, section 3 unit 1

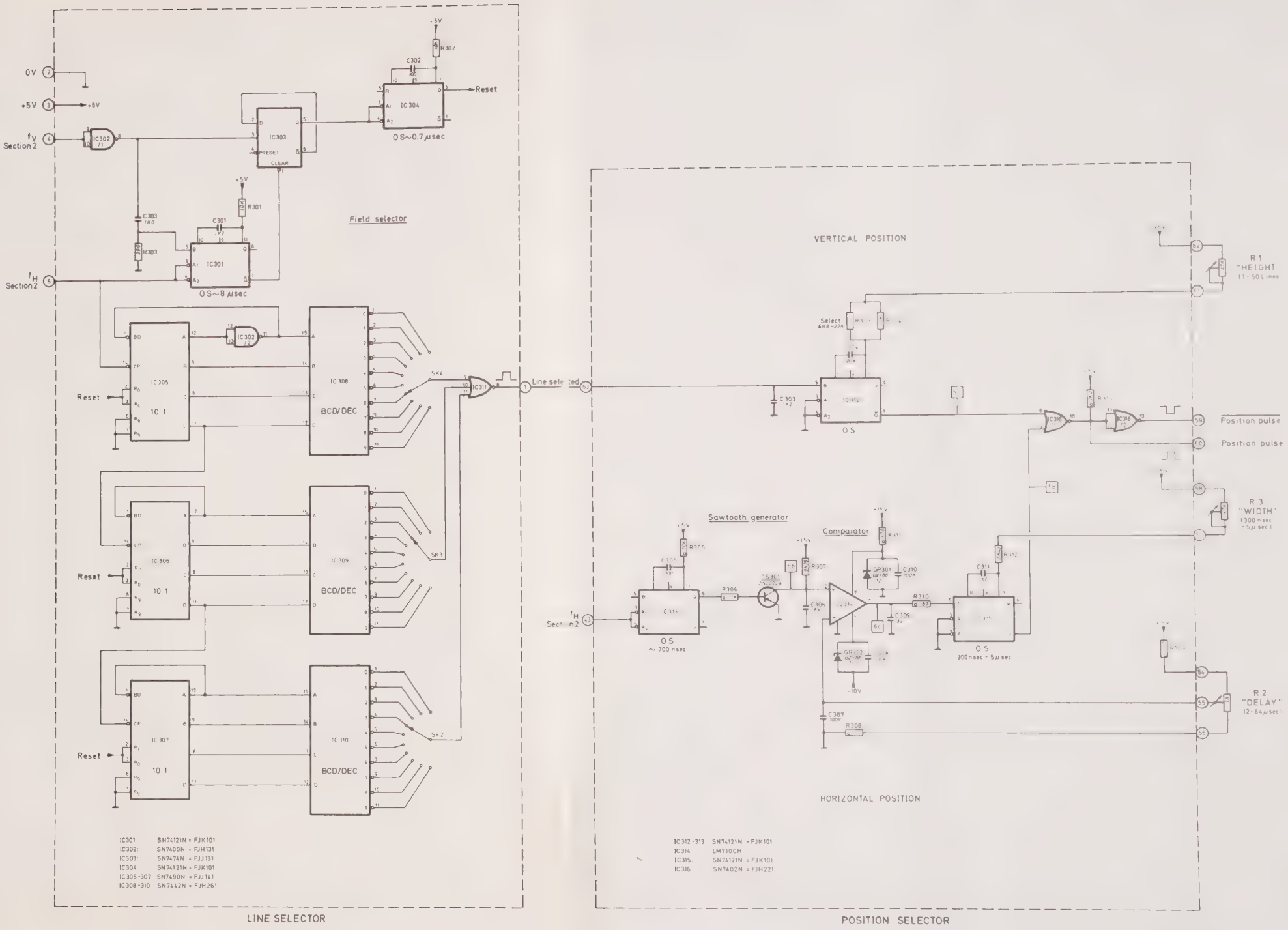


Fig. 10-4 Circuit diagram, line and position selector, section 3

11. Section 4. Video, sampling and marker circuit

A video signal with superimposed subcarrier applied to terminal 18 will via the emitter follower TS401 reach the notch filter, which removes the subcarrier. The filtered signal is amplified five times in the video amplifier which has a very high open loop gain, so that the amplification is determined by the ratio between precision resistors only. Besides being fed to the clamp circuit the signal "5 x VIDEO" is also applied to the video and marker amplifier.

In the clamp circuit the clamp transistor TS426 is controlled by a pulse, situated at the back porch of the sync. This pulse is derived from the clamp pulse generator which consists of two one-shot generators IC401/1 and 2.

The one-shot generators are controlled by the two sync pulses f_H and f_V.

All the levels in the measurements are referred to this clamp level i.e. black level at zero millivolt. The clamped signal is then passed through a video follower with high input impedance, low output impedance and with an offset-adjustment. The low output impedance is necessary for the following sample and hold circuit, which is formed by the low leakage capacitor C408, the MOS FET transistor TS412 with low on-resistance and finally the FET operational amplifier IC402 operating as signal follower.

The sampling pulse, derived from the position selector will via TS411 open the gate at TS412 and transfer the source level to C408.

The sampling can be indicated on a monitor screen by a marker pulse, forming a field; the position and size of this area are controlled by four controls, see section 3. The larger this area, the faster the measurements. The zero adjustment for the instrument is screwdriver control (R4) on the front panel determining the offset voltage for the signal follower, which was a low output impedance. The DC level from the sampler is led to the A/D converter via terminal 52. The marker control has three positions i.e. positive, negative and off. On a monitor screen it will show respectively a light, a dark or none field.

The marker circuit consists of a marker pulse generator and an amplifier.

The marker pulse is made by a clamp circuit consisting of the transistordriver TS413 and the MOS-transistor TS414. With the MOS-transistor cut off, the output level is determined by the position of the marker switch and then the voltage is amplified and transferred to the marker output terminal BU2 and the Video and Marker amplifier.

Checking and adjusting

Measuring equipment :

Oscilloscope : e.g. PHILIPS PM 3240X
Test signal generator: e.g. PHILIPS PM 5533 or PM 5570

Make sure the adjustments of section 1 (Power Supply) are done correctly before starting with the following adjustments.

Video amplifier

Supply a measuring signal, for instance a grey scale with or without superimposed subcarrier to input BU1 "VIDEO IN" and to the oscilloscope. Check that the signal at pin 17 has an amplitude 5 x bigger with respect to the input signal.
By means of R417 it is possible to compensate the tolerances in the feed-back resistor network R414 to R418. (See fig. 11-1 Oscillogram 13).

DC off-set

Supply a measuring signal, for instance a grey scale with or without superimposed subcarrier to input BU1 "VIDEO IN". Connect the two channels of the oscilloscope to the basis of TS407a and TS407b respectively. Check that in the blanking period the dc content of the two signals is equal.
If not, readjust R429.

Subcarrier suppression

Supply a measuring signal, for instance a grey scale signal with superimposed subcarrier to input BU1 "VIDEO IN".
Connect the oscilloscope to pin 17.
The subcarrier content in the signal should be a minimum (typical -40dB).
If not, readjust L401.

Frequency response of video amplifier

Supply a measuring signal, for instance a sweep signal to input BU1 "VIDEO IN".
Connect the oscilloscope to output BU3 "VIDEO + MARKER".
A typical frequency response is shown in fig. 11-1a, page 42.
The valley point should be at the subcarrier frequency (see subcarrier suppression).
The higher frequency content is adjusted by means of C404 (frequency response).
CAUTION ! Avoid internal oscillations by overadjusting capacitor C404.

Marker pulse response

Supply a measuring signal, for instance a grey scale signal to input BU1 "VIDEO IN".
Connect the oscilloscope to output BU3 "VIDEO + MARKER".
The capacitor C412 should be adjusted to minimum spikes on the marker pulse.

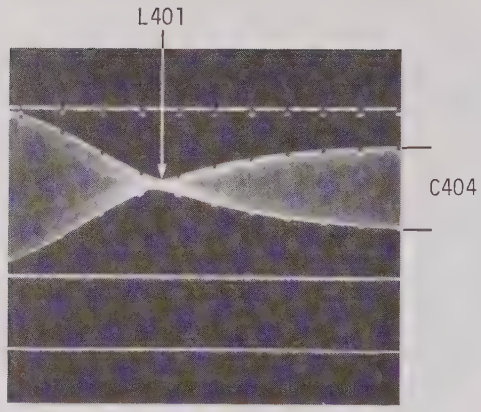
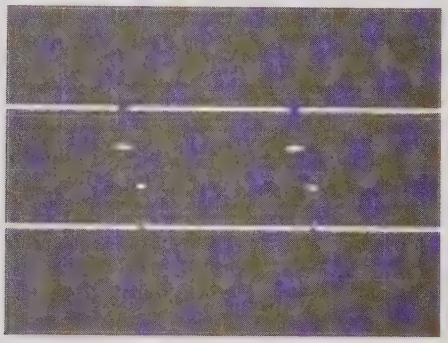


Fig. 11-1a Typical frequency response

Position of clamp pulse

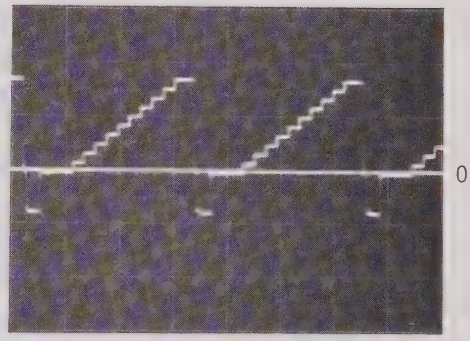


5V/div. 20µs/div

a. ref. f_H (43)

b. clamp pulse [8b]

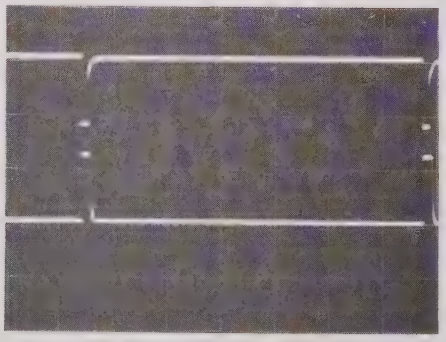
Clamped video signal



2V/div. 20µs/div.

a. clamped video signal [9a]

Sampling pulse

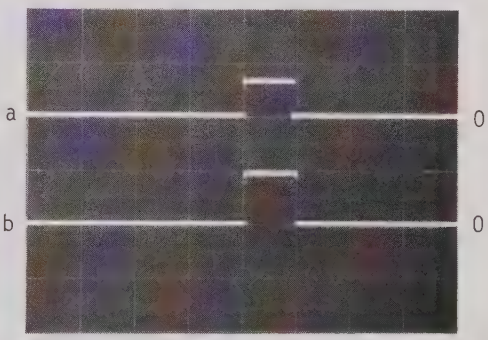


10µs/div.

a. ref. position pulse (16) 5V/div.

b. sampling [10b] 20V/div.

Marker pulse



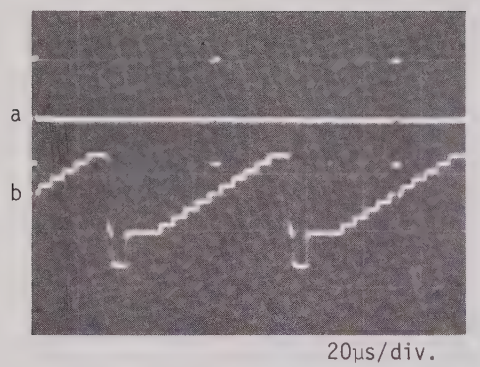
5µs/div.

a. ref. position pulse (9) 5V/div.

b. marker pulse [11b] 0.5V/div.

Fig. 11-1 Oscillograms, video sampling and marker circuit, section 4

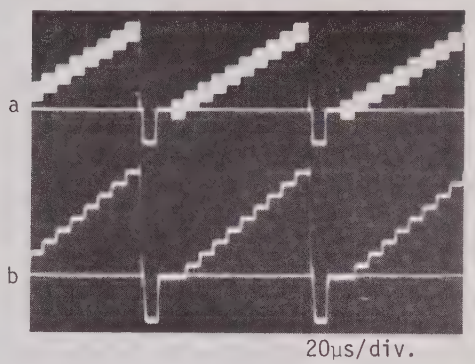
Output signals



a. ref. "MARKER BU2 5V/div.

b. "VIDEO+MARKER" BU3 0.5V/div.

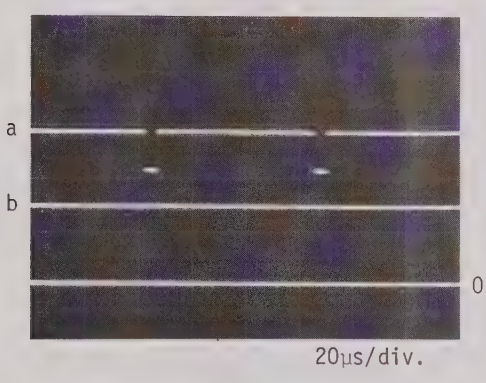
Grey scale with superimposed subcarrier



a. input signal (18) 0.5V/div.

b. 5 x video (17) 2V/div.

DC-level (4th step of 10 step grey scale)



a. ref. f_H (43) 5V/div.

b. DC output (52) 1V/div.

Fig. 11-1 Oscillograms, section 4

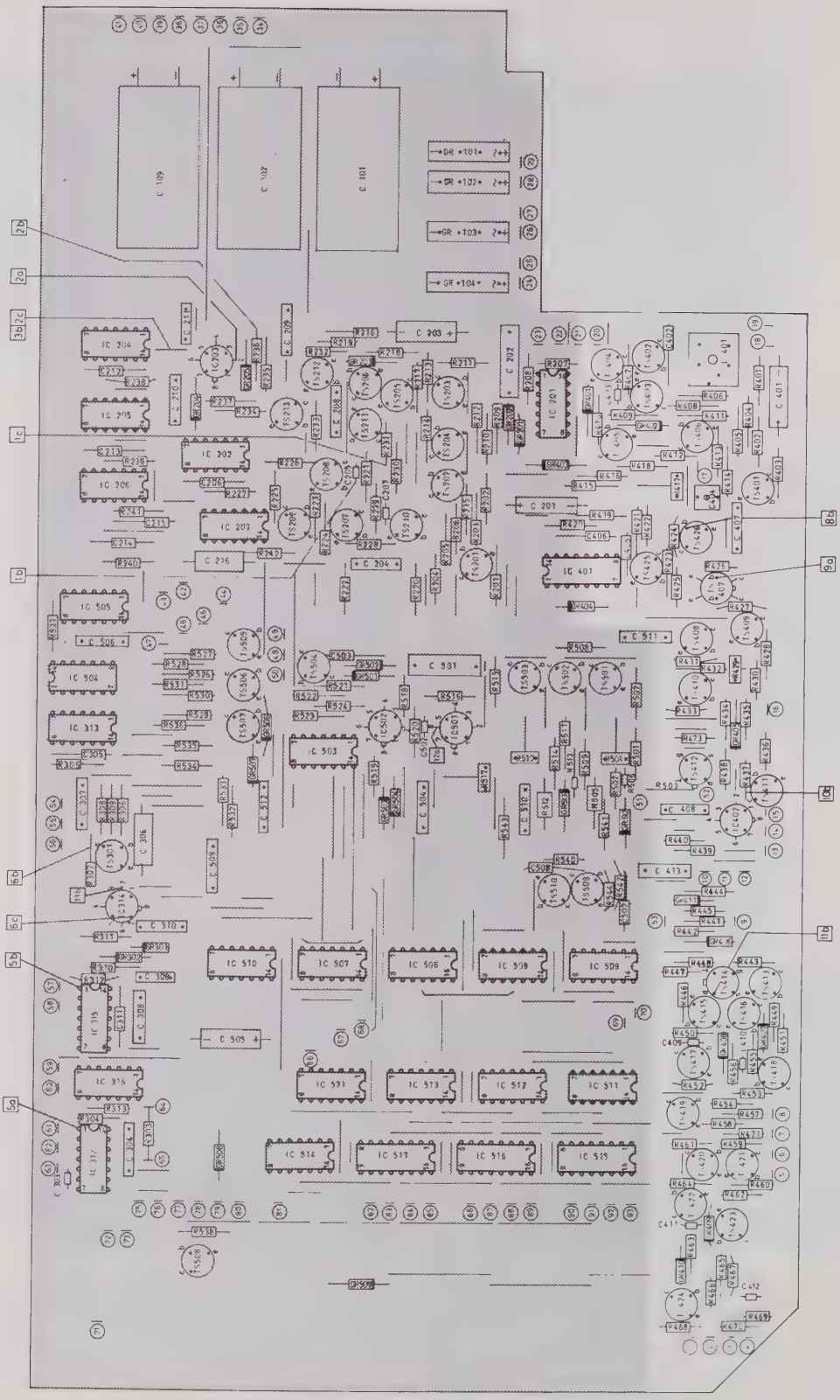


Fig. 11-2 Component location, video, sampling and marker, section 4

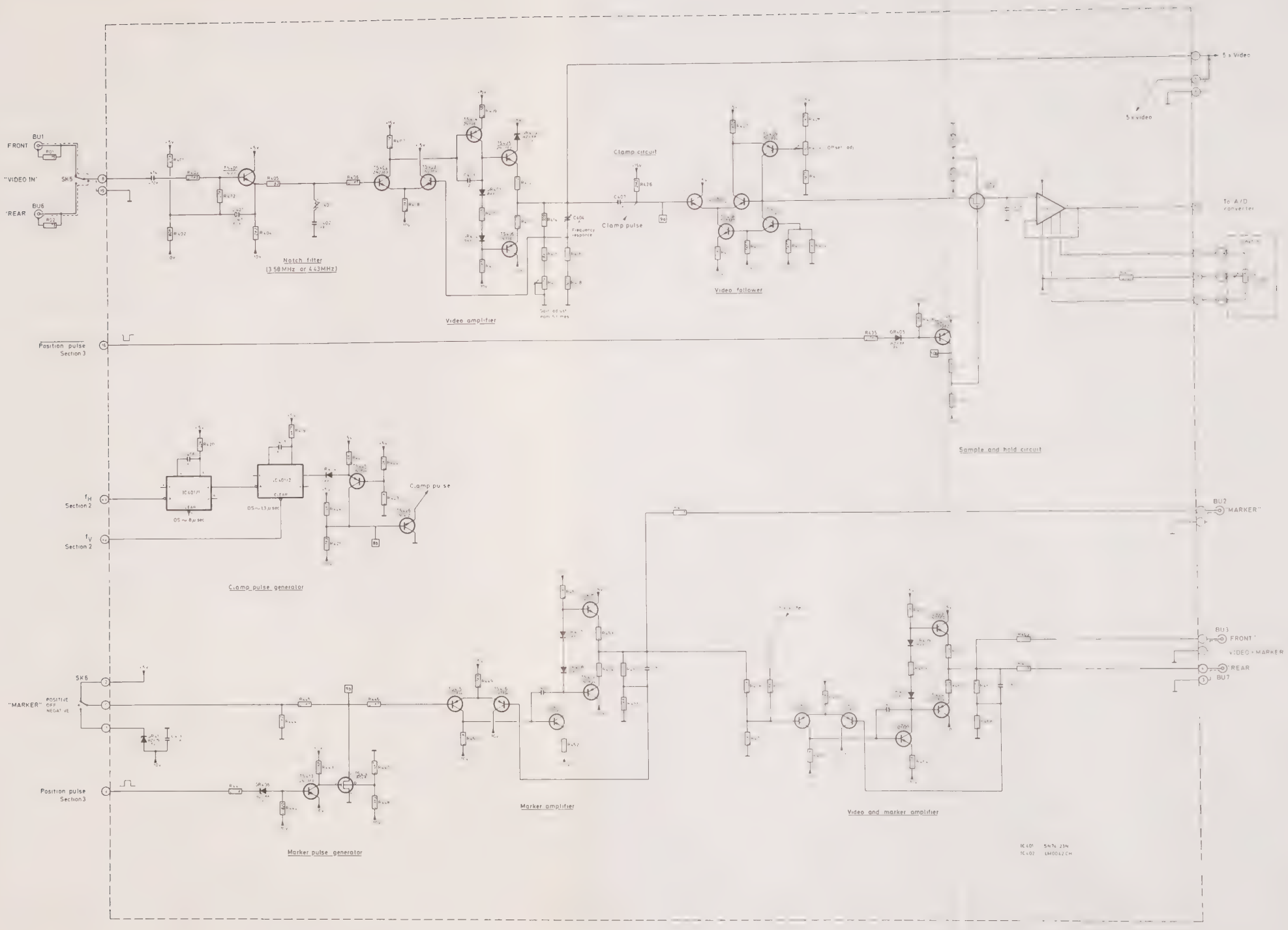


Fig. 11-3 Circuit diagram, video, sampling and marker, section 4

12. Section 5. A/D converter

Conversion of DC voltage from the sampling and hold circuit into digital form is based on the dual slope principle. The analogue signal (terminal 51) is applied to the integrator (IC501) via series resistors and switching transistors. The integrator supplies an output pulse, the width of which is proportional to the measured value. There are two conditions for the integrator, called: upwards integration and downwards integration. During the first step (start) the output voltage of the integrator increases linearly as a function of time; its direction depends on the polarity and its steepness on the value of the input voltage. The upwards integration time is determined by the duration of 1000 clock pulses in the counter system (IC511, 512, 513 and 514/1).

At the end of the first step the polarity of the integration voltage is determined and indicated on the display.

The decoding element IC521 gives a pulse equal to count 1998, which initiates the downwards integration and at the same time sets the counter to zero.

During the second step the integrator is discharged to zero by a constant current. The time is measured by counting clock pulses: it is directly proportional to the unknown input voltage applied during the first step.

The same integration elements and clock generator are employed for both steps. Temperature variations, long term drift and absolute values will therefore not affect measuring accuracy.

As soon as the voltage on the integrating capacitor (C501) passes through zero during the discharge process, the gate IC509/1 is closed, and the content of the counter system is transferred to the memory (IC515, 516, 517 and 514/1), converted to a seven-segment code and displayed on the high bright display.

Any absence of line sync pulses (f_H) is detected by one-shot IC504. The Q output stops the A/D conversion while $\overline{Q}$ causes the decimal points on the display to be illuminated.

Checking and adjusting

Measuring equipment :

Oscilloscope : e.g. PHILIPS PM 3240X
Video calibration generator: e.g. PHILIPS PM 5546

Make sure the adjustments of section 1 (Power Supply) are done correctly before starting with the following adjustments.

Integrator

Without any signal the display should show 000mV.
If not, the potentiometer R517 has to be readjusted.

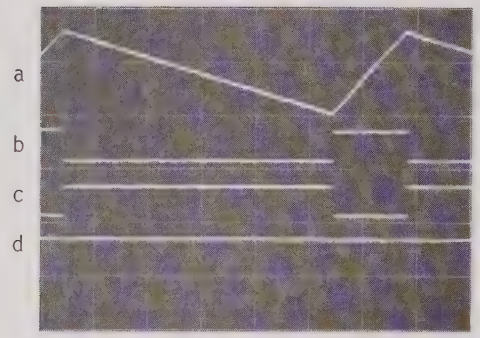
Zero level

Supply a very precise video signal - for instance a white reference signal - to the input and turn the screwdriver control "ZERO ADJ." in such a position that the display shows 000mV, when measuring at pure blanking level.

Positive and negative reference voltage

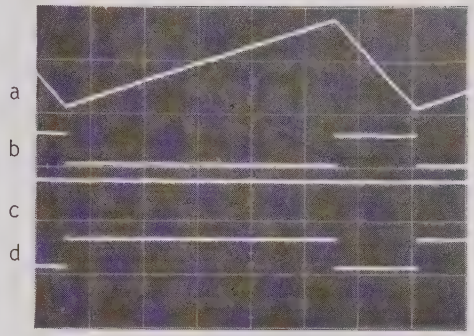
Set potentiometers R504 and R510 in the centre position and turn R417 into a position so that the white reference level and the sync level is nearly correct. Adjust R504 so that the display shows 700mV when the white reference is measured. Adjust R510 so that the display shows -300mV when the sync level is measured.
The oscilloscope will show the area measured, determined by the 4 relevant front-panel controls.

Generation of dual slope ramp



20ms/div.

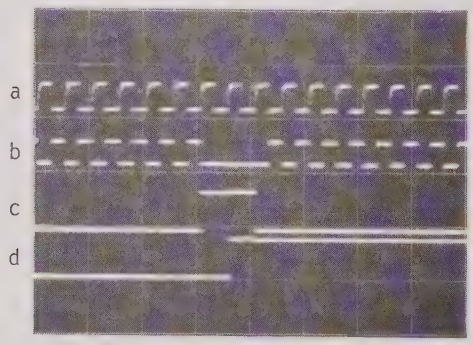
a. integrator voltage	15a	1V/div.
b. switch signal S1	48	5V/div.
c. switch signal S2	49	5V/div.
d. switch signal S3	50	5V/div.



20ms/div.

a. integrator voltage	16a	1V/div.
b. switch signal S1	48	5V/div.
c. switch signal S2	49	5V/div.
d. switch signal S3	50	5V/div.

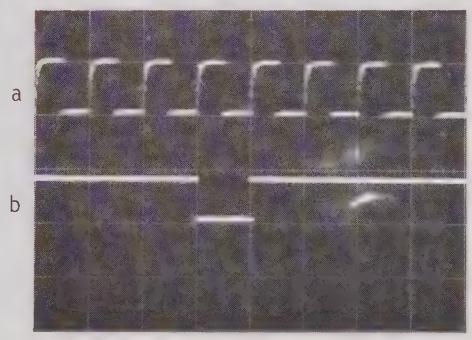
Clock and reset pulses (chopped)



0.2ms/div.

a. clock osc. 10kHz	70	10V/div.
b. gated clock	69	10V/div.
c. reset pulse	68	5V/div.
d. reset pulse	67	5V/div.

"1998" pulse (chopped)



0.1ms/div.

a. clock osc. 10kHz	70	5V/div.
b. "1998" pulse	66	5V/div.

Fig. 12-1 Oscillograms, A/D converter, section 5

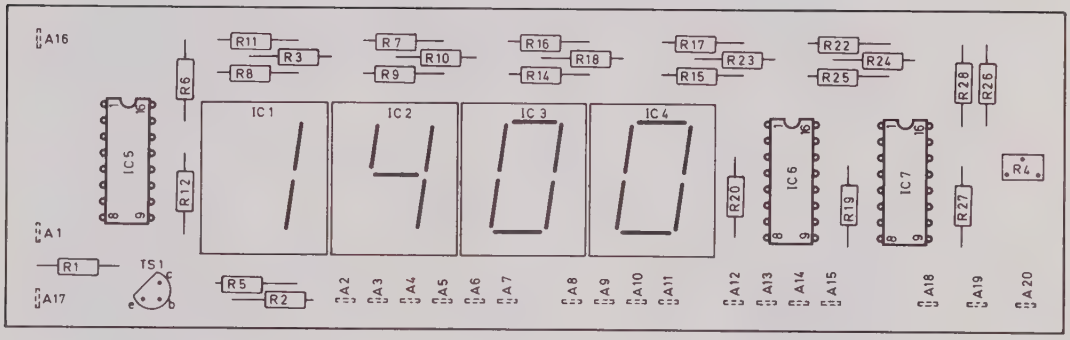


Fig. 12-2 Component location, Display unit, section 5 unit 5

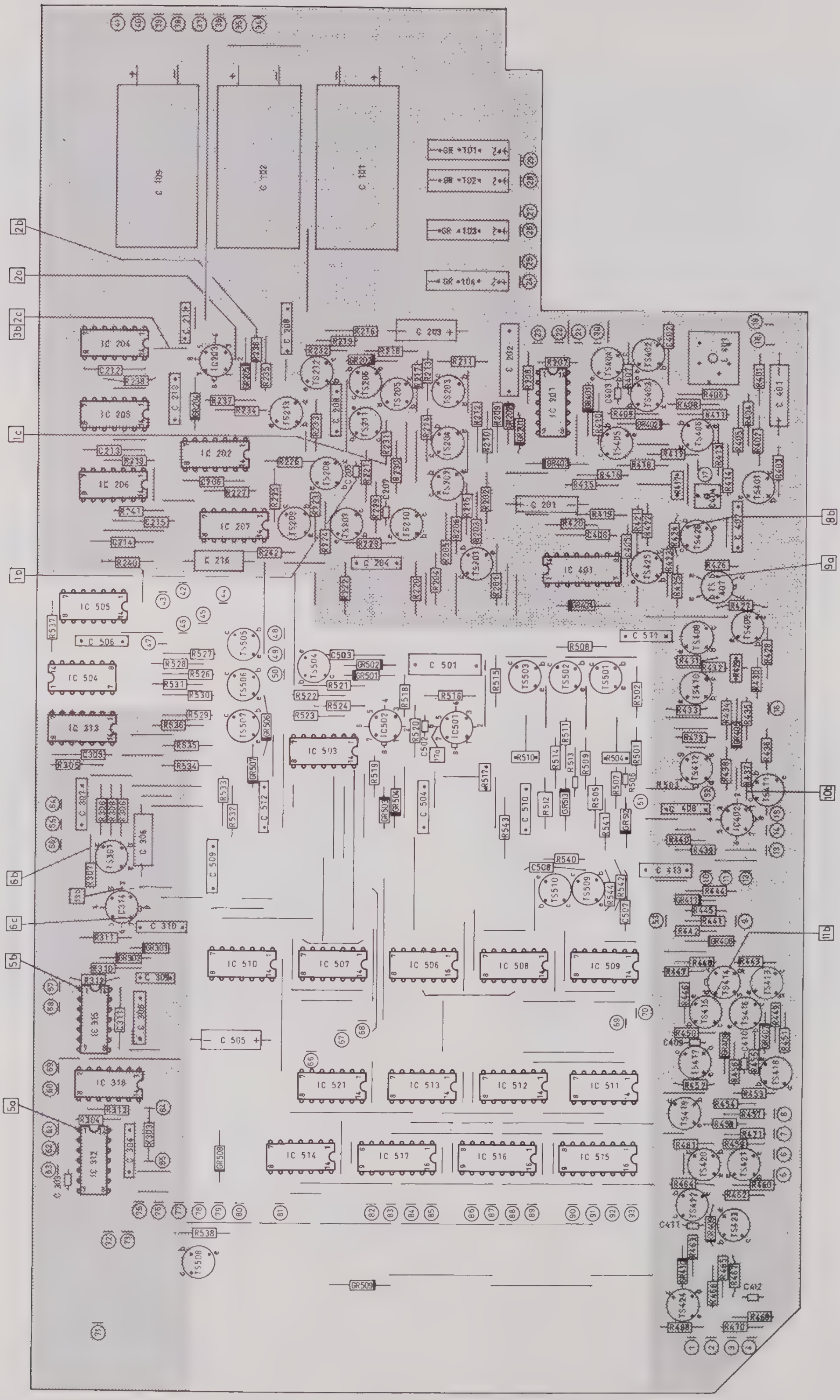


Fig. 12-3 Component location, A/D converter, section 5

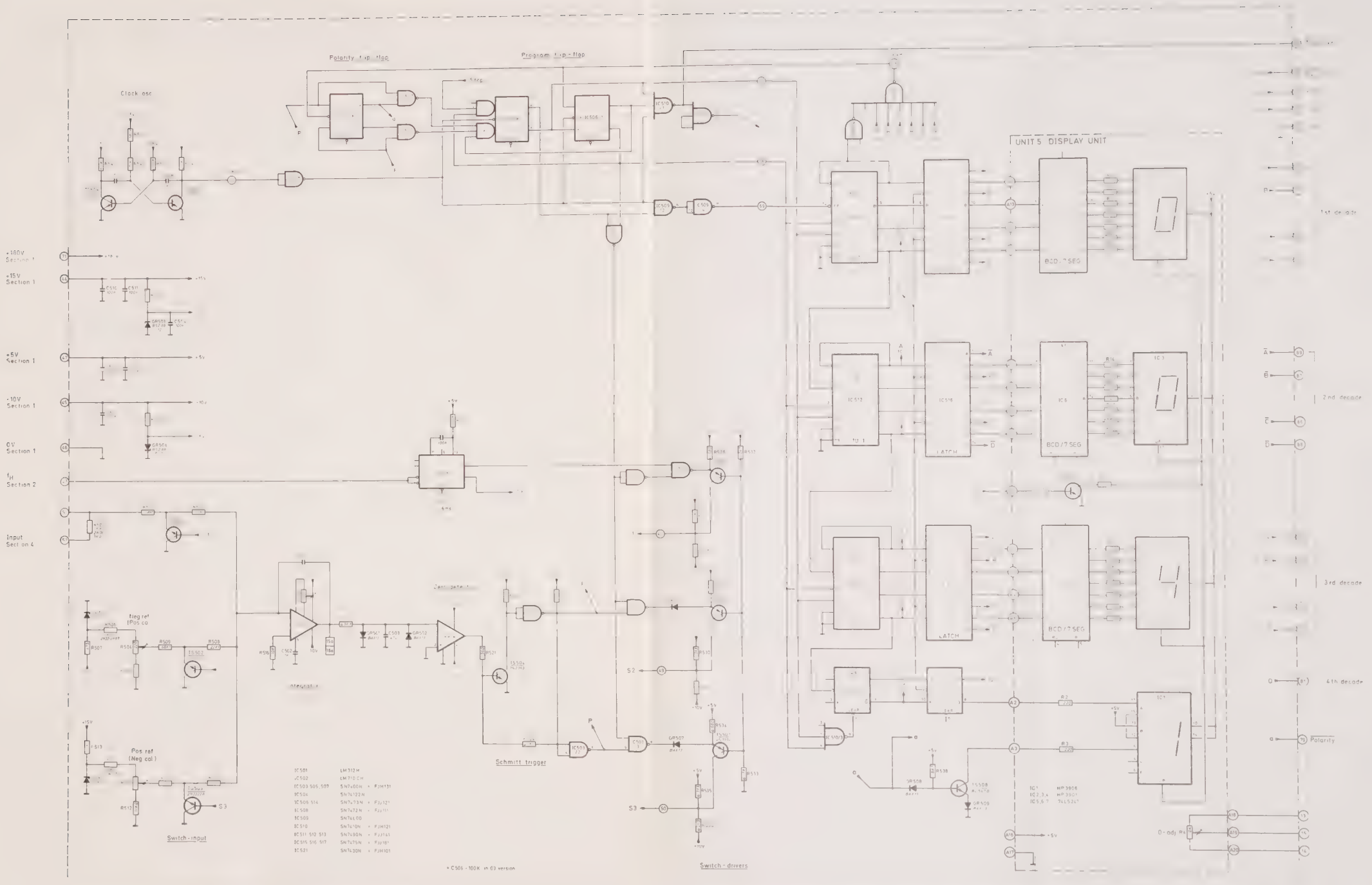


Fig. 12-4 Circuit diagram, A/D converter + display unit, section 5

13. Unit 4. PM8509 BCD output (optional)

By means of PM 8509 it is possible to obtain digital information from the video level meter which is useful in applications involving printers, go/no-go testers, remote displays etc.

The digital information - derived from the memory via isolation amplifiers - contains data and control signals: Result, Polarity, Transfer and Stop signal.

With an external pulse it is possible to start/stop the measurement via the connector.

The high level of the BCD code from the option can be any voltage between +5V and +12V by changing the value of the zenerdiode GR601 mounted at two solder tags called e and j. This feature allows the use of the digital output signals in several systems. The option is delivered with +12V voltage level.

SN7406 or SN7416 are used as buffer amplifiers. The IC's are hex inverted buffers/ drivers with open-collector output. The one bit code for polarity is converted to a two-bit code in accordance to the specifications for the Philips printer PM 2466.

The one bit code for the fourth decade result ("10^3") is converted to a four bit code by connecting three terminals to earth. The start/stop pulse configuration allows many amplitudes to be used. From terminal 46 the printer PM 2466 will send a "hold off" pulse with a duration of 1 sec. In this period no measurement will be carried out.

Mounting

- Disconnect PM 5548 from the mains and pull out the chassis of the cabinet.
- Insert the printboard in the clamps at the video level unit.
  The component side should face the rearplate.
- Fasten the Amphenol connector to the rearplate and mount the wiring cable to the sidewall.
- Place the instrument in the cabinet again.

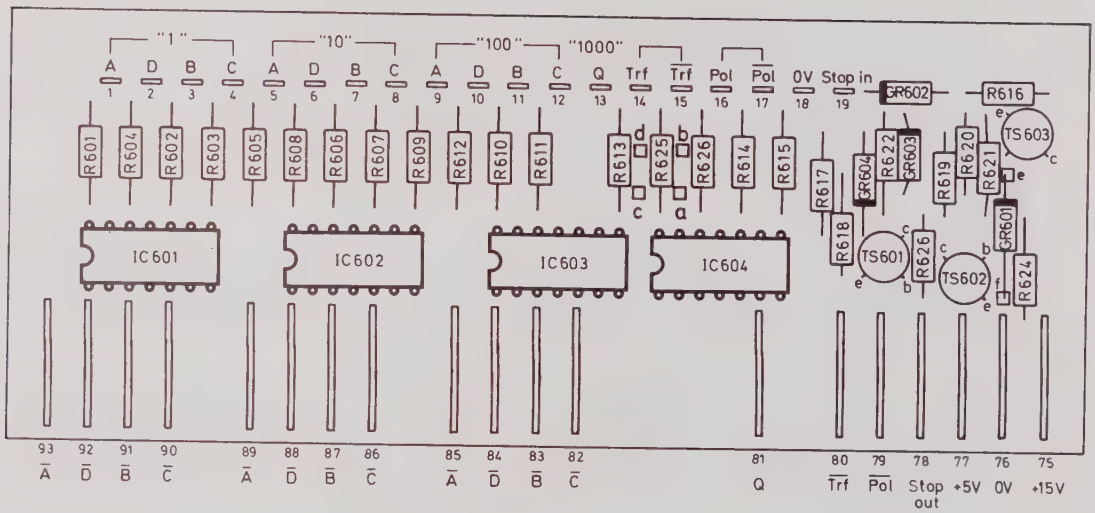


Fig. 13-1 Component location, BCD output, unit 4

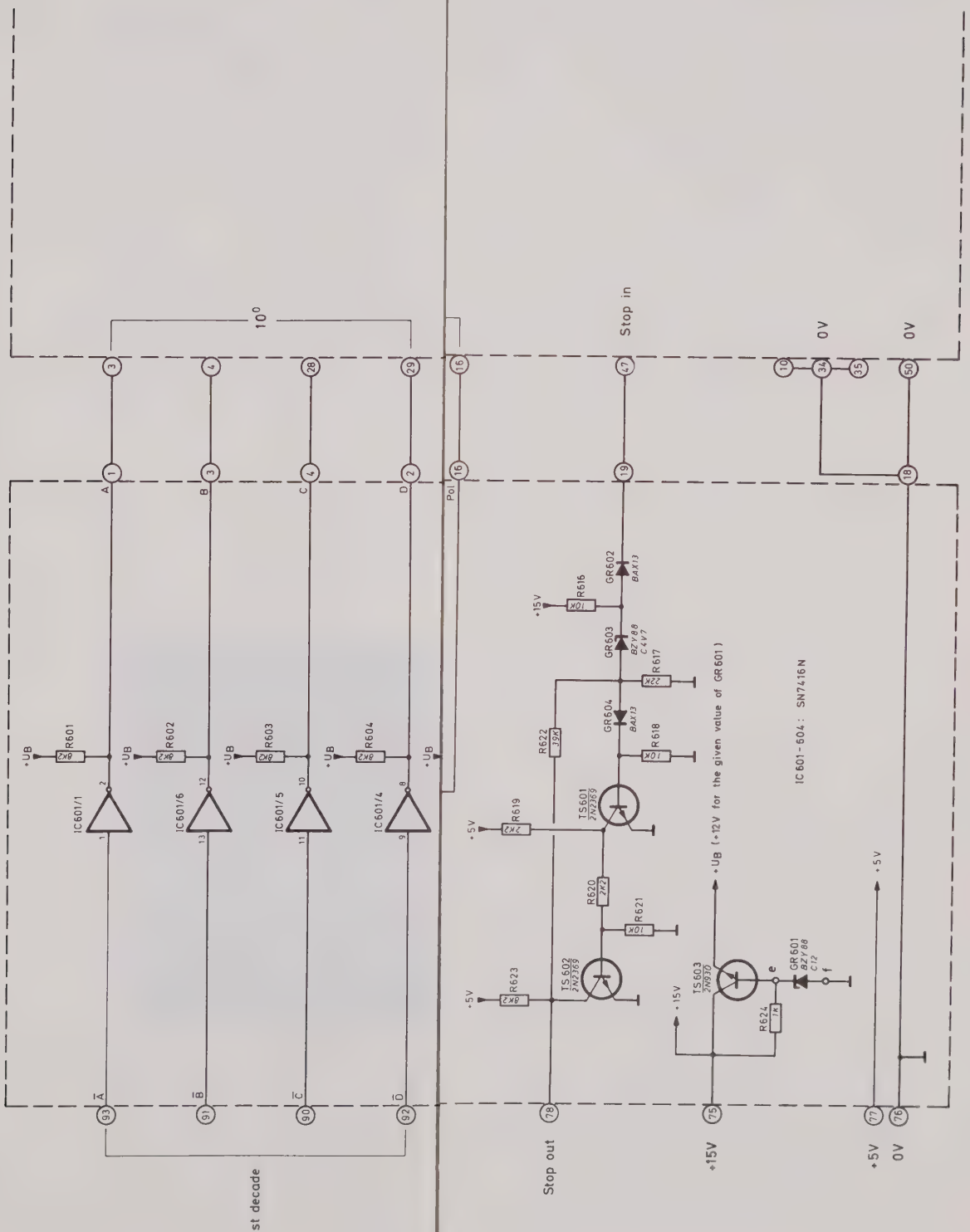


Fig. 13-2 Circuit diagram, BCD output, unit 4

14. Access to and replacement of parts

A. Removing the chassis

1. Loosen the two screws "A"
2. Turn the two locking brackets "B" forward
3. Pull out the chassis

B. Removing the textplate

1. Remove the chassis as indicated in section "A"
2. Remove the screws underneath the locking brackets "B"
3. Remove the fixing nuts which hold the switches
4. Remove the knobs (R1, R2 and R3)
5. Remove the ornamental strip
   The textplate can now be removed.

C. Removing the line selector

1. Remove the chassis as indicated in sections A and B
3. Remove the four screws situated around the switch block (SK2, 3 and 4)
   The circuit board can now be removed from the frontplate.

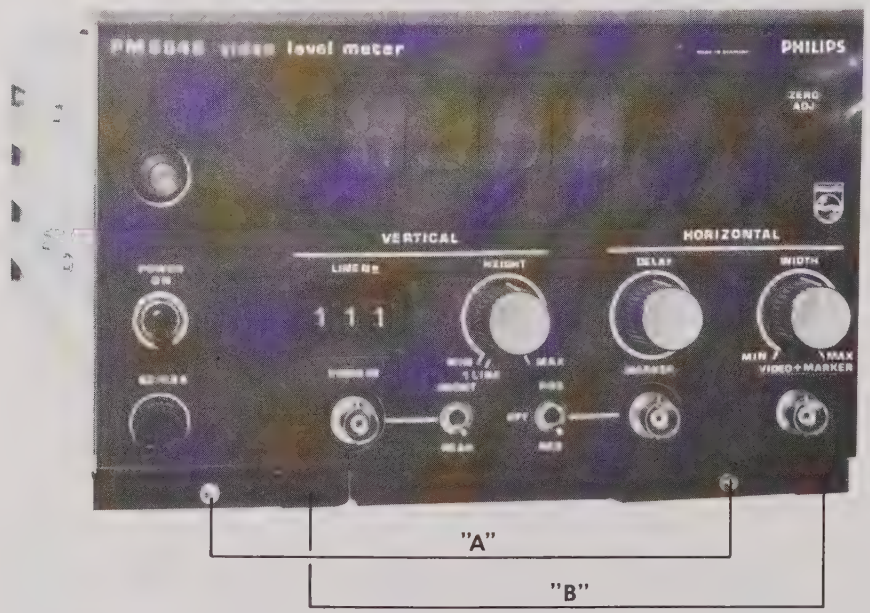


Fig. 14-1 Front of the instrument

15. Maintenance

A. Switches

Should the switches cease to function properly due to dirty contacts, they should be treated with a switch oil.
This oil should have both cleaning and lubricating properties.
After using this oil, the switch should be operated a few times.

B. Cabinet

The P.V.C. coated cabinet can be cleaned with soap and water (first remove chassis, chapter 13).
If necessary, a fine scouring detergent can be used.

16. List of mechanical parts

Item	Description	Quantity	Ordering number
1	Textplate (dark grey)	1	5322 456 90009
2	Ornamental strip	1	5322 460 64006
3	Lampholder	1	5322 255 10078
4	Lamp	1	5322 134 40264
5	Switch	1	4822 277 10021
6	Fuseholder	1	5322 256 40017
7	Fuse 230V/315mA (delayed action)	1	4822 253 30014
	Fuse 115V/630mA (delayed action)	(1)	4822 253 30018
8	Thumbweelswitch	3	5322 273 14025
9	BNC connector	7	5322 267 10004
10	Switch	1	5322 277 10169
11	Switch	1	5322 277 10205
12	Knob	2	5322 414 74023
13	Knob	1	5322 414 34144
14	Cap for knob	3	5322 414 74021
15	Potentiometer 10K, R4	1	5322 100 10141
16	Switch	1	5322 277 10214
17	Socket (mains con. 3 pole)	1	5322 265 30066
18	Earthconnector	1	5322 290 40011
19	Earthconnector	1	5322 290 40012
	Potentiometer 1K, R2	1	5322 103 54011
	Potentiometer 47K, R1	1	4822 101 50129
	Potentiometer 47K, R3	1	4822 101 20302
	Mains cord	1	5322 321 14018
	Terminating plug (75Ω)	2	5322 263 60033
	BCD output connector (not shown)	1	5322 267 70015

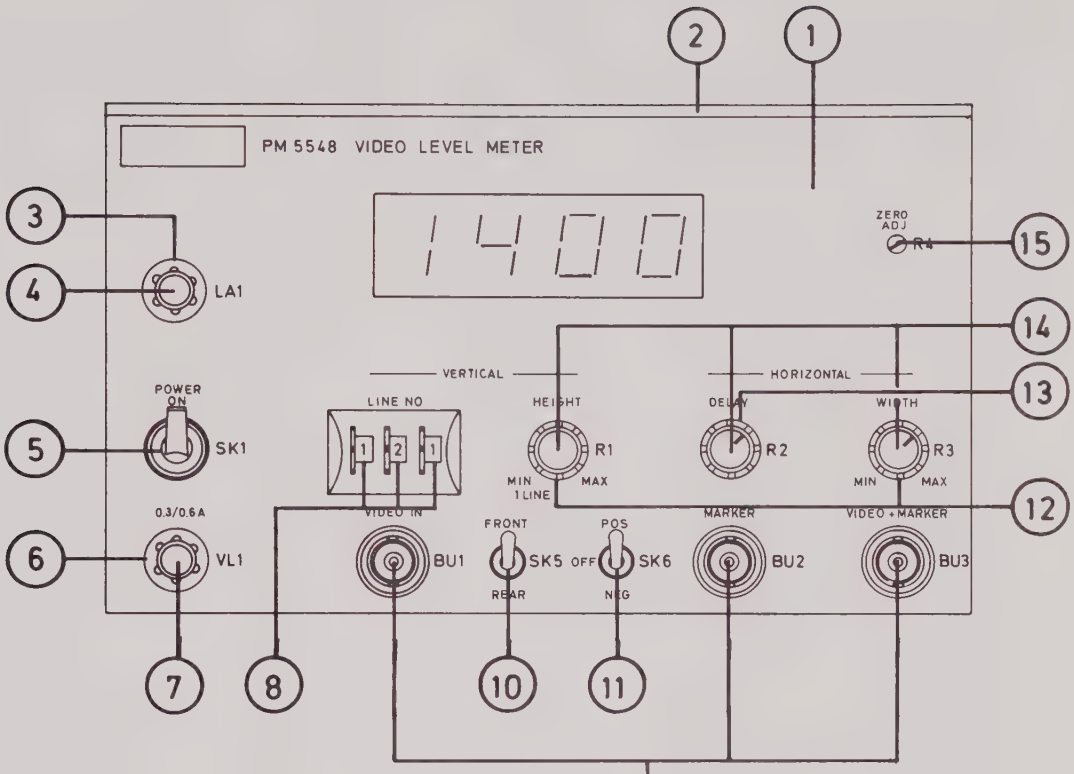


Fig. 16-1 Front of the instrument

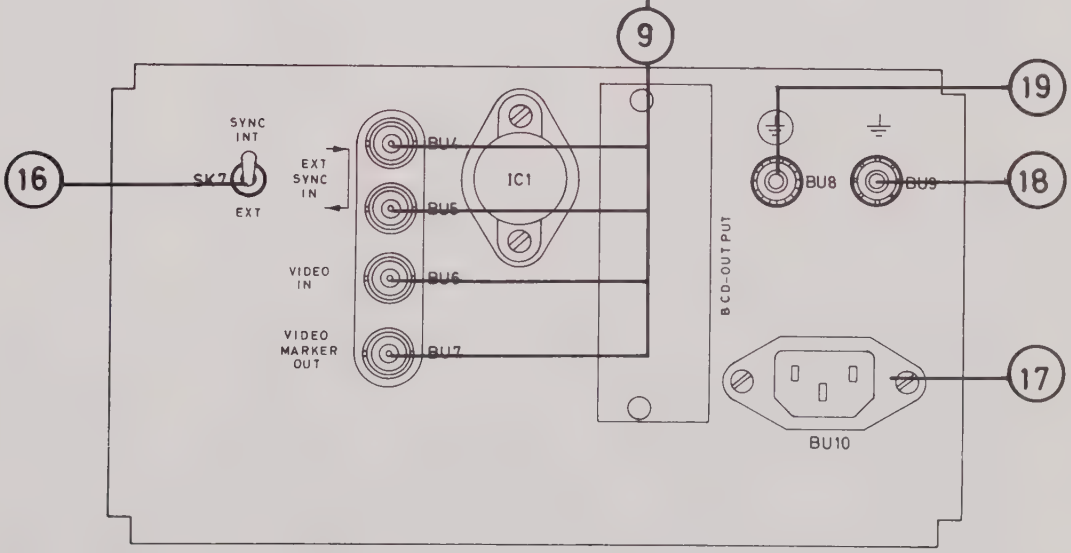


Fig. 16-2 Rear of the instrument

17. List of electrical parts

Diagramnumber	Description	Value	% Watt/Volt	Ordering number
T1	Transformer			5322 146 44017
	Tubeholder			5322 255 34055
	IC-socket			5322 255 44073
	IC-socket			5322 255 44074
	Coil	3.4mH		5322 156 24076
	Resistor	75	1%	5322 116 54775
Section 1				
C101	Electrolytic cap.	3300M	25V	5322 124 74045
C102-C109	Electrolytic cap.	2200M	40V	4822 124 70252
C103-C107	Electrolytic cap.	15M	10V	5322 124 24008
C104-C106	Capacitor	150P		4822 121 50416
C105	Electrolytic cap.	10M	16V	5322 124 24089
R101-R105	Resistor	3.01K	1%	5322 116 50524
R102	Resistor	301	1%	5322 116 54508
R103	Resistor	15K	1%	5322 116 54001
R104-R111	Resistor	2.7	10%	5322 113 60099
R106-R113	Potentiometer	470		5322 100 10148
R107-R114	Resistor	2.67K	1%	5322 116 54578
R108	Resistor	909	1%	5322 116 54545
R109	Resistor	475	1%	5322 116 54007
R110	Resistor	10K	1%	5322 116 54619
R112	Resistor	1K	1%	5322 116 54549
L101-L102	Coil			5322 158 10052
Section 2				
C201-C203	Electrolytic cap.	15M	10V	5322 124 24008
C202	Capacitor	1M		5322 121 40197
C204	Capacitor	220N		4822 121 40232
C205	Capacitor	22P		4822 122 31063
C206	Capacitor	1.2N		4822 121 50439
C207	Capacitor	100P		4822 122 31081
C208-C210	Capacitor	100N		5322 121 40323
C209	Capacitor	22N		5322 121 40308
C211	Capacitor	33P		4822 122 31202
C212	Capacitor	2.7N		4822 121 50474

Diagramnumber	Description	Value	% Watt/Volt	Ordering number
Section 2				
C213-C215	Capacitor	1.2N		4822 121 50439
C214	Capacitor	150P		4822 121 50416
C216	Capacitor	10N	1% 63V	4822 121 50097
R227	Resistor	3.57K	1% MR25	5322 116 54586
R238-R242	Resistor	30.1K	1%	5322 116 54655
R239	Resistor	10K	1% MR25	5322 116 54619
R241	Resistor	6.81K	1%	5322 116 54012
R003	Resistor	120	1%	4822 110 53083
Section 3				
C301	Capacitor	1.2K		4822 121 50439
C302	Capacitor	100P		4822 121 50562
C303	Capacitor	1K	10% 100V	4822 122 31175
C304-C307	Capacitor	100K		5322 121 40323
C305	Capacitor	100P		4822 121 50562
C306	Capacitor	18K		5322 121 54113
C308-C310	Capacitor	100K		5322 121 40323
C309	Capacitor	39P	5% 500V	4822 120 11069
C311	Capacitor	150P	1% 500V	4822 121 50416
R304	Resistor	1.1K	1%	5322 116 54554
R307	Resistor	9.09K	1%	5322 116 54615
R312	Resistor	2.43K	1% MR25	5322 116 54004
Section 4				
C401	Electrolytic cap.	22M	20% 6.3V	5322 124 24033
C402	Capacitor	390P		4822 121 50418
C403-C409	Capacitor	12P	2% 63V	4822 122 31056
C404	Trimmer	2-18P	300V	5322 125 50051
C405	Capacitor	820P		5322 121 54072
C406	Capacitor	1.2K		4822 121 50439
C407	Capacitor	100K		5322 121 40323
C408	Capacitor	15K		5322 121 40301
C410	Capacitor	10P		4822 122 31054
C411-C412	Capacitor	12P	2% 63V	4822 122 31056
C413	Capacitor	220K	10% 100V	4822 121 40232
C414	Capacitor	470K	10% 100V	4822 121 40218

Diagramnumber	Description	Value	% Watt/Volt	Ordering number
Section 4				
R414	Resistor	900	1/4%	5322 116 50765
R415	Resistor	8.25K	1%	5322 116 54558
R416	Resistor	200	1/4%	5322 116 50267
R417	Potentiometer	47		5322 101 14048
R418	Resistor	24.3	1%	5322 116 54435
R419	Resistor	4.75K	1%	5322 116 54008
R420	Resistor	22.1K	1%	5322 116 54574
R427	Resistor	1.5K	1% MR25	5322 116 54564
R428-R434	Resistor	2.21K	1%	5322 116 54564
R429	Potentiometer	500		5322 100 10148
R430	Resistor	3.01K	1%	5322 116 50524
R431	Resistor	1K	1%	5322 116 54549
R432	Resistor	1.62K	1%	5322 116 54565
R433	Resistor	2.67K	1%	5322 116 54578
R457-R469	Resistor	75	1%	5322 116 54459
R470	Resistor	75	1%	5322 116 54459
R473	Resistor	2.21K	1%	5322 116 54574
Section 5				
C501	Capacitor	1M	10% 100V	5322 121 40197
C502	Capacitor	1K	10% 100V	4822 122 31175
C503	Capacitor	470P		4822 121 50553
C504	Capacitor	100K		5322 121 40323
C505	Electrolytic cap.	22M	6.3V	5322 124 24033
C506	Capacitor	100K		5322 121 40323
C507-C508	Capacitor	3.3K		5322 121 54049
C509-C510	Capacitor	100K	10% 100V	5322 121 40323
R501	Resistor	68.1K	1/4%	5322 116 55015
R502-R508	Resistor	22.1K	1%	5322 116 50532
R503	Resistor	2K	1% MR24E	5322 116 54064
R503	Resistor	2.21K	1% MR24E	5322 116 54171
R503-R506-R511	Resistor	2.32K	1% MR24E	5322 116 51038
R503-R506-R511	Resistor	2.43K	1% MR24E	5322 116 50971
R503-R506-R511	Resistor	2.55K	1% MR24E	5322 116 54193
R503-R506-R511	Resistor	2.67K	1% MR24E	5322 116 50784
R503-R506-R511	Resistor	2.8K	1% MR24E	5322 116 55016
R503-R506-R511	Resistor	2.87K	1% MR24E	5322 116 54291
R503	Resistor	3.01K	1% MR24E	5322 116 54218

Diagramnumber	Description	Value	% Watt/Volt	Ordering number
Section 5				
R504-R510	Potentiometer	470		5322 101 14047
R505-R512	Resistor	11K	1/4% MR39E	5322 116 51056
R507	Resistor	475	1% MR25	5322 116 54007
R509-R514	Resistor	68.1K	1/4% MR39E	5322 116 55015
R513	Resistor	1.1K	1% MR25	5322 116 50842
R515	Resistor	22.1K	1/4% MR39E	5322 116 54174
R516	Resistor	10K	1%	5322 116 54619
R517	Potentiometer	100K		5322 101 14071
R541	Resistor	6.19K	1%	5322 116 50608
R542	Resistor	51.1K	1%	5322 116 50672

Semi-conductors

Type	Ordering number
BC547B	4822 130 40959
BD131	5322 130 40752
BSV78=2N4856A	5322 130 44093
BSV81	5322 130 44041
BSX21	5322 130 40321
2N930	5322 130 40051
2N2222A	5322 130 44115
2N2369	5322 130 40407
2N2432	5322 130 40424
2N2453A	5322 130 44261
2N2894	5322 130 40018
2N2905	5322 130 40021
2N3962	5322 130 44245
BAX13	5322 130 40182
BY164	5322 130 30414
BY179	5322 130 30521
BSZ88/C12	5322 130 34069
BZX79/C5V1	5322 130 30767
BZX79/C12	5322 130 34069
BZY88/C3V3	5322 130 30392
BZY88/C3V9	5322 130 30411
BZY88/C4V7	5322 130 30264
BZY88/C6V2	5322 130 30781
BZY88/C9V1	5322 130 30667
BZY88/C12	5322 130 34069
1N825	5322 130 30742

Integrated circuits

Type	Ordering number
HP3901	5322 209 81052
HP3906	5322 209 81053
LH0042CH	5322 209 84395
LM309K	5322 209 84247
LM312H	5322 209 84784
LM710CH	5322 209 84396
LM723CD	5322 209 84397
SN7400N=FJH131	5322 209 84528
SN74L00	5322 209 84187
SN7402N=FJH221	5322 209 84145
SN7410N=FJH121	5322 209 80077
SN7416N	5322 209 84035
SN7427N	5322 209 84398
SN7430N=FJH101	5322 209 80138
SN7442N=FJH261	5322 209 84226
SN7472N=FJJ111	5322 209 80107
SN7473N=FJJ121	5322 209 84142
SN7474N=FJJ131	5322 209 80065
SN7475N=FJJ181	5322 209 80059
SN7490N=FJJ141	5322 209 84114
SN7412N=FJK101	5322 209 84122
SN74122N	5322 209 84231
SN74123N	5322 209 83723
SN74LS247	5322 209 85613

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
3 2	1 5 0 4 7 5	0 P M 3 2 6 0 0 2	D O 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤ *Nature of call*

- [ ] Installation
- [ ] Pre sale repair
- [ ] Preventive maintenance
- [X] Corrective maintenance
- [ ] Other

Location: 0 0 2 1

Component/sequence no.

T	S	0	6	0	7
R	0	0	6	3	1
9	9	0	0	0	1

Category: 5 / 2 / 4

⑦ *Job completed*: [X]

Working time ⑧: 1 2 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version O P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

[ ][ ][ ][ ]

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

[ ][ ][ ][ ][ ][ ]

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

[ ]

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

[ ][ ][1][2] = 1,2 working hours (1 h 12 min.)

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